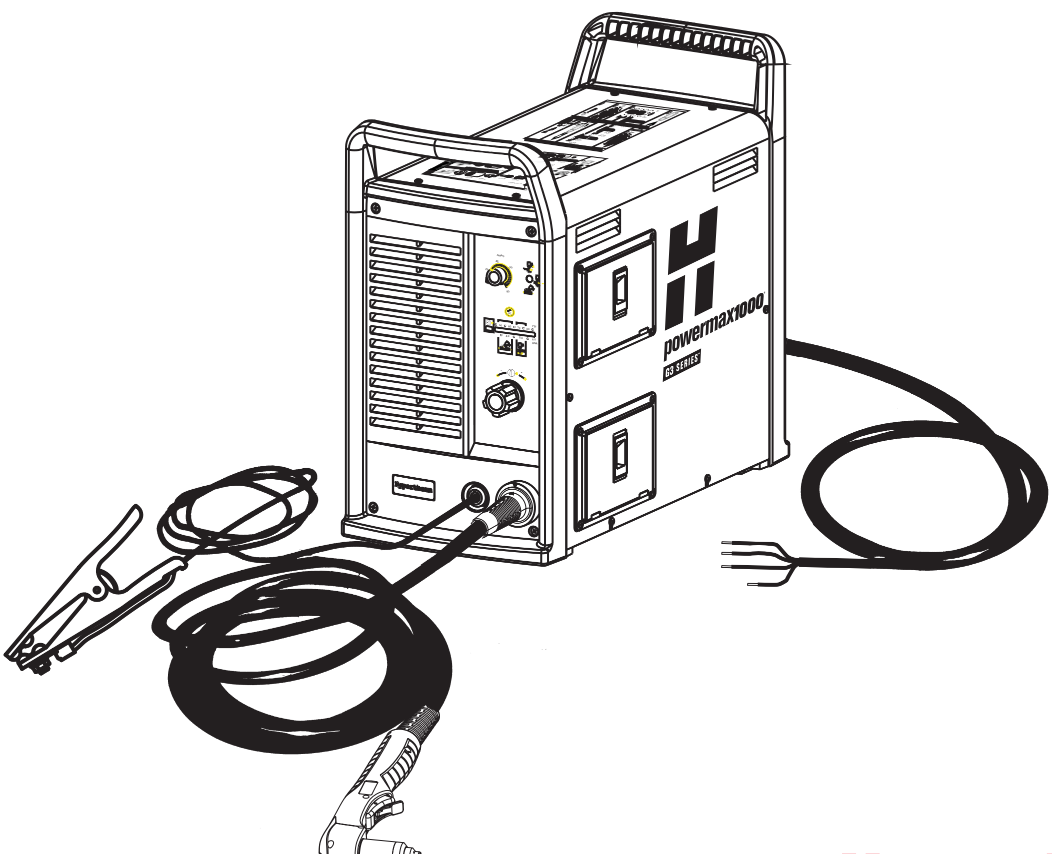
powermax1000®

Plasma Arc
Cutting System

Service Manual
804300 Revision 0



Hypertherm®

The world leader in plasma cutting technology™

powermax1000

Service Manual

(P/N 804300)

Revision 0 December, 2001

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7/13/01

EMC INTRODUCTION

Hypertherm's CE-marked equipment is built in compliance with standard EN50199. The equipment should be installed and used in accordance with the information below to achieve electromagnetic compatibility.

The limits required by EN50199 may not be adequate to completely eliminate interference when the affected equipment is in close proximity or has a high degree of sensitivity. In such cases it may be necessary to use other measures to further reduce interference.

This plasma equipment is designed for use only in an industrial environment.

INSTALLATION AND USE

The user is responsible for installing and using the plasma equipment according to the manufacturer's instructions. If electromagnetic disturbances are detected then it shall be the responsibility of the user to resolve the situation with the technical assistance of the manufacturer. In some cases this remedial action may be as simple as earthing the cutting circuit, see *Earthing of Workpiece*. In other cases it could involve constructing an electromagnetic screen enclosing the power source and the work complete with associated input filters. In all cases electromagnetic disturbances must be reduced to the point where they are no longer troublesome.

ASSESSMENT OF AREA

Before installing the equipment the user shall make an assessment of potential electromagnetic problems in the surrounding area. The following shall be taken into account:

a. Other supply cables, control cables, signalling and telephone cables; above, below and adjacent to the cutting equipment.
b. Radio and television transmitters and receivers.
c. Computer and other control equipment.
d. Safety critical equipment, for example guarding of industrial equipment.
e. Health of the people around, for example the use of pacemakers and hearing aids.
f. Equipment used for calibration or measurement.
g. Immunity of other equipment in the environment. User shall ensure that other equipment being used in the environment is compatible. This may require additional protection measures.
h. Time of day that cutting or other activities are to be carried out.

The size of the surrounding area to be considered will depend on the structure of the building and other activities that are taking place. The surrounding area may extend beyond the boundaries of the premises.

METHODS OF REDUCING EMISSIONS

Mains Supply

Cutting equipment must be connected to the mains supply according to the manufacturer's recommendations. If interference occurs, it may be necessary to take additional precautions such as filtering of the mains supply. Consideration should be given to shielding the supply cable of permanently installed cutting equipment, in metallic conduit or equivalent. Shielding should be electrically continuous throughout its length. The shielding should be connected to the cutting mains supply so that good electrical contact is maintained between the conduit and the cutting power source enclosure

Maintenance of Cutting Equipment

The cutting equipment must be routinely maintained according to the manufacturer's recommendations. All access and service doors and covers should be closed and properly fastened when the cutting equipment is in operation. The cutting equipment should not be modified in any way except for those changes and adjustments covered in the manufacturer's instructions. In particular, the spark gaps of arc striking and stabilizing devices should be adjusted and maintained according to the manufacturer's recommendations.

Cutting Cables

The cutting cables should be kept as short as possible and should be positioned close together, running at or close to the floor level.

Equipotential Bonding

Bonding of all metallic components in the cutting installation and adjacent to it should be considered. However, metallic components bonded to the workpiece will increase the risk that the operator could receive a shock by touching these metallic components and the electrode at the same time. The operator should be insulated from all such bonded metallic components.

Earthing of Workpiece

Where the workpiece is not bonded to earth for electrical safety, nor connected to earth because of its size and position, for example, ship's hull or building steelwork, a connection bonding the workpiece to earth may reduce emissions in some, but not all instances. Care should be taken to prevent the earthing of the workpiece increasing the risk of injury to users, or damage to other electrical equipment. Where necessary, the connection of the workpiece to earth should be made by a direct connection to the workpiece, but in some countries where direct connection is not permitted, the bonding should be achieved by suitable capacitances selected according to national regulations.

Note. The cutting circuit may or may not be earthed for safety reasons. Changing the earthing arrangements should only be authorized by a person who is competent to assess whether the changes will increase the risk of injury, for example, by allowing parallel cutting current return paths which may damage the earth circuits of other equipment. Further guidance is given in IEC TC26 (sec)94 and IEC TC26/108A/CD Arc Welding Equipment Installation and Use.

Screening and Shielding

Selective screening and shielding of other cables and equipment in the surrounding area may alleviate problems of interference. Screening of the entire plasma cutting installation may be considered for special applications

WARNING

Genuine Hypertherm parts are the factory-recommended replacement parts for your Hypertherm system. Any damage caused by the use of other than genuine Hypertherm parts may not be covered by the Hypertherm warranty.

WARNING

You are responsible for the safe use of the Product. Hypertherm does not and cannot make any guarantee or warranty regarding the safe use of the Product in your environment.

GENERAL

Hypertherm, Inc. warrants that its Products shall be free from defects in materials and workmanship, if Hypertherm is notified of a defect (i) with respect to the power supply within a period of two (2) years from the date of its delivery to you, with the exception of G3 Series power supplies, which shall be within a period of three (3) years from the date of delivery to you, and (ii) with respect to the torch and leads within a period of one (1) year from its date of delivery to you. This warranty shall not apply to any Product which has been incorrectly installed, modified, or otherwise damaged. Hypertherm, at its sole option, shall repair, replace, or adjust, free of charge, any defective Products covered by this warranty which shall be returned with Hypertherm's prior authorization (which shall not be unreasonably withheld), properly packed, to Hypertherm's place of business in Hanover, New Hampshire, or to an authorized Hypertherm repair facility, all costs, insurance and freight prepaid. Hypertherm shall not be liable for any repairs, replacement, or adjustments of Products covered by this warranty, except those made pursuant to this paragraph or with Hypertherm's prior written consent. **The warranty above is exclusive and is in lieu of all other warranties, express, implied, statutory, or otherwise with respect to the Products or as to the results which may be obtained therefrom, and all implied warranties or conditions of quality or of merchantability or fitness for a particular purpose or against infringement. The foregoing shall constitute the sole and exclusive remedy for any breach by Hypertherm of its warranty**. Distributors/OEMs may offer different or additional warranties, but Distributors/OEMs are not authorized to give any additional warranty protection to you or make any representation to you purporting to be binding upon Hypertherm.

PATENT INDEMNITY

Except only in cases of products not manufactured by Hypertherm or manufactured by a person other than Hypertherm not in strict conformity with Hypertherm's specifications and in cases of designs, processes, formulae, or combinations not developed or purported to be developed by Hypertherm, Hypertherm will defend or settle, at its own expense, any suit or proceeding brought against you alleging that the use of the Hypertherm product, alone and not in combination with any other product not supplied by Hypertherm, infringes any patent of any third party. You shall notify Hypertherm promptly upon learning of any action or threatened action in connection with any such alleged infringement, and Hypertherm's obligation to indemnify shall be conditioned upon Hypertherm's sole control of, and the indemnified party's cooperation and assistance in, the defense of the claim.

LIMITATION OF LIABILITY

In no event shall Hypertherm be liable to any person or entity for any incidental, consequential, indirect, or punitive damages (including but not limited to lost profits) regardless of whether such liability is based on breach of contract, tort, strict liability, breach of warranties, failure of essential purpose or otherwise and even if advised of the possibility of such damages.

LIABILITY CAP

In no event shall Hypertherm's liability, whether such liability is based on breach of contract, tort, strict liability, breach of warranties, failure of essential purpose or otherwise, for any claim action suit or proceeding arising out of or relating to the use of the Products exceed in the aggregate the amount paid for the Products that gave rise to such claim.

INSURANCE

At all times you will have and maintain insurance in such quantities and types, and with coverage sufficient and appropriate to defend and to hold Hypertherm harmless in the event of any cause of action arising from the use of the Products.

NATIONAL AND LOCAL CODES

National and Local codes governing plumbing and electrical installation shall take precedent over any instructions contained in this manual. **In no event** shall Hypertherm be liable for injury to persons or property damage by reason of any code violation or poor work practices.

TRANSFER OF RIGHTS

You may transfer any remaining rights you may have hereunder only in connection with the sale of all or substantially all of your assets or capital stock to a successor in interest who agrees to be bound by all of the terms and conditions of this Warranty.

Hypertherm

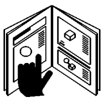
Section 1

SAFETY

In this section:

RECOGNIZE SAFETY INFORMATION

The symbols shown in this section are used to identify potential hazards. When you see a safety symbol in this manual or on your machine, understand the potential for personal injury, and follow the related instructions to avoid the hazard.



FOLLOW SAFETY INSTRUCTIONS

Read carefully all safety messages in this manual and safety labels on your machine.

- Keep the safety labels on your machine in good condition. Replace missing or damaged labels immediately.
- Learn how to operate the machine and how to use the controls properly. Do not let anyone operate it without instruction.
- Keep your machine in proper working condition. Unauthorized modifications to the machine may affect safety and machine service life.

DANGER WARNING CAUTION

A signal word DANGER or WARNING is used with a safety symbol. DANGER identifies the most serious hazards.

- DANGER and WARNING safety labels are located on your machine near specific hazards.
- WARNING safety messages precede related instructions in this manual that may result in injury or death if not followed correctly.
- CAUTION safety messages precede related instructions in this manual that may result in damage to equipment if not followed correctly.



CUTTING CAN CAUSE FIRE OR EXPLOSION

Fire Prevention

- Be sure the area is safe before doing any cutting. Keep a fire extinguisher nearby.
- Remove all flammables within 35 feet (10 m) of the cutting area.
- Quench hot metal or allow it to cool before handling or before letting it touch combustible materials.
- Never cut containers with potentially flammable materials inside – they must be emptied and properly cleaned first.
- Ventilate potentially flammable atmospheres before cutting.
- When cutting with oxygen as the plasma gas, an exhaust ventilation system is required.

Explosion Prevention

- Do not use the plasma system if explosive dust or vapors may be present.
- Do not cut pressurized cylinders, pipes, or any closed container.
- Do not cut containers that have held combustible materials.

WARNING

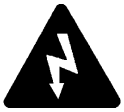
Explosion Hazard
Argon-Hydrogen and Methane

Hydrogen and methane are flammable gases that present an explosion hazard. Keep flames away from cylinders and hoses that contain methane or hydrogen mixtures. Keep flames and sparks away from the torch when using methane or argon-hydrogen plasma.

WARNING

Hydrogen Detonation with Aluminum Cutting

- When cutting aluminum underwater, or with the water touching the underside of the aluminum, free hydrogen gas may collect under the workpiece and detonate during plasma cutting operations.
- Install an aeration manifold on the floor of the water table to eliminate the possibility of hydrogen detonation. Refer to the Appendix section of this manual for aeration manifold details.




ELECTRIC SHOCK CAN KILL

Touching live electrical parts can cause a fatal shock or severe burn.

- Operating the plasma system completes an electrical circuit between the torch and the workpiece. The workpiece and anything touching the workpiece are part of the electrical circuit.
- Never touch the torch body, workpiece or the water in a water table when the plasma system is operating.

Electric Shock Prevention

All Hypertherm plasma systems use high voltage in the cutting process (200 to 400 VDC are common). Take the following precautions when operating this system:

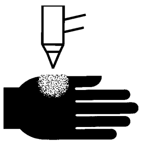
- Wear insulated gloves and boots, and keep your body and clothing dry.
- Do not stand, sit or lie on – or touch – any wet surface when using the plasma system.
- Insulate yourself from work and ground using dry insulating mats or covers big enough to prevent any physical contact with the work or ground. If you must work in or near a damp area, use extreme caution.
- Provide a disconnect switch close to the power supply with properly sized fuses. This switch allows the operator to turn off the power supply quickly in an emergency situation.
- When using a water table, be sure that it is correctly connected to earth ground.
- Install and ground this equipment according to the instruction manual and in accordance with national and local codes.
- Inspect the input power cord frequently for damage or cracking of the cover. Replace a damaged power cord immediately. **Bare wiring can kill.**
- Inspect and replace any worn or damaged torch leads.
- Do not pick up the workpiece, including the waste cutoff, while you cut. Leave the workpiece in place or on the workbench with the work cable attached during the cutting process.
- Before checking, cleaning or changing torch parts, disconnect the main power or unplug the power supply.
- Never bypass or shortcut the safety interlocks.
- Before removing any power supply or system enclosure cover, disconnect electrical input power. Wait 5 minutes after disconnecting the main power to allow capacitors to discharge.
- Never operate the plasma system unless the power supply covers are in place. Exposed power supply connections present a severe electrical hazard.
- When making input connections, attach proper grounding conductor first.
- Each Hypertherm plasma system is designed to be used only with specific Hypertherm torches. Do not substitute other torches which could overheat and present a safety hazard.



CUTTING CAN PRODUCE TOXIC FUMES

Cutting can produce toxic fumes and gases that deplete oxygen and cause injury or death.

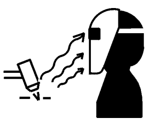
- Keep the cutting area well ventilated or use an approved air-supplied respirator.
- Do not cut in locations near degreasing, cleaning or spraying operations. The vapors from certain chlorinated solvents decompose to form phosgene gas when exposed to ultraviolet radiation.
- Do not cut metal coated or containing toxic materials, such as zinc (galvanized), lead, cadmium or beryllium, unless the area is well ventilated and the operator wears an air-supplied respirator. The coatings and any metals containing these elements can produce toxic fumes when cut.
- Never cut containers with potentially toxic materials inside – they must be emptied and properly cleaned first.
- This product, when used for welding or cutting, produces fumes or gases which contain chemicals known to the State of California to cause birth defects and, in some cases, cancer.



A PLASMA ARC CAN CAUSE INJURY AND BURNS

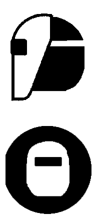
Instant-On Torches
Plasma arc comes on immediately when the torch switch is activated.

The plasma arc will cut quickly through gloves and skin.
- Keep away from the torch tip.
- Do not hold metal near the cutting path.
- Never point the torch toward yourself or others.



ARC RAYS CAN BURN EYES AND SKIN

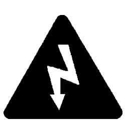
Eye Protection Plasma arc rays produce intense visible and invisible (ultraviolet and infrared) rays that can burn eyes and skin.
- Use eye protection in accordance with applicable national or local codes.
- Wear eye protection (safety glasses or goggles with side shields, or a welding helmet) with appropriate lens shading to protect your eyes from the arc's ultraviolet and infrared rays.



Arc Current	Lens Shade AWS (USA)	Lens Shade ISO 4850
Up to 100 A	No. 8	No. 11
100-200 A	No. 10	No. 11-12
200-400 A	No. 12	No. 13
Over 400 A	No. 14	No. 14

Skin Protection Wear protective clothing to protect against burns caused by ultraviolet light, sparks and hot metal.
- Gauntlet gloves, safety shoes and hat.
- Flame-retardant clothing to cover all exposed areas.
- Cuffless trousers to prevent entry of sparks and slag.
- Remove any combustibles, such as a butane lighter or matches, from your pockets before cutting.

Cutting Area Prepare the cutting area to reduce reflection and transmission of ultraviolet light:
- Paint walls and other surfaces with dark colors to reduce reflection.
- Use protective screens or barriers to protect others from flash and glare.
- Warn others not to watch the arc. Use placards or signs.



GROUNDING SAFETY

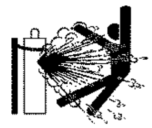
Work Cable Attach the work cable securely to the workpiece or the work table with good metal-to-metal contact. Do not connect it to the piece that will fall away when the cut is complete.

Work Table Connect the work table to an earth ground, in accordance with appropriate national or local electrical codes.

Input Power
- Be sure to connect the power cord ground wire to the ground in the disconnect box.
- If installation of the plasma system involves connecting the power cord to the power supply, be sure to connect the power cord ground wire properly.
- Place the power cord's ground wire on the stud first, then place any other ground wires on top of the power cord ground. Fasten the retaining nut tightly.
- Tighten all electrical connections to avoid excessive heating.

COMPRESSED GAS EQUIPMENT SAFETY

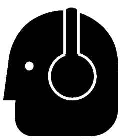
- Never lubricate cylinder valves or regulators with oil or grease.
- Use only correct gas cylinders, regulators, hoses and fittings designed for the specific application.
- Maintain all compressed gas equipment and associated parts in good condition.
- Label and color-code all gas hoses to identify the type of gas in each hose. Consult applicable national or local codes.



GAS CYLINDERS CAN EXPLODE IF DAMAGED

Gas cylinders contain gas under high pressure. If damaged, a cylinder can explode.

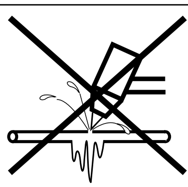
- Handle and use compressed gas cylinders in accordance with applicable national or local codes.
- Never use a cylinder that is not upright and secured in place.
- Keep the protective cap in place over valve except when the cylinder is in use or connected for use.
- Never allow electrical contact between the plasma arc and a cylinder.
- Never expose cylinders to excessive heat, sparks, slag or open flame.
- Never use a hammer, wrench or other tool to open a stuck cylinder valve.



NOISE CAN DAMAGE HEARING

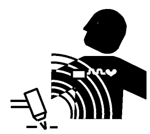
Prolonged exposure to noise from cutting or gouging can damage hearing.

- Use approved ear protection when using plasma system.
- Warn others nearby about the noise hazard.



A PLASMA ARC CAN DAMAGE FROZEN PIPES

Frozen pipes may be damaged or can burst if you attempt to thaw them with a plasma torch.



PACEMAKER AND HEARING AID OPERATION

Pacemaker and hearing aid operation can be affected by magnetic fields from high currents.

Pacemaker and hearing aid wearers should consult a doctor before going near any plasma arc cutting and gouging operations.

To reduce magnetic field hazards:

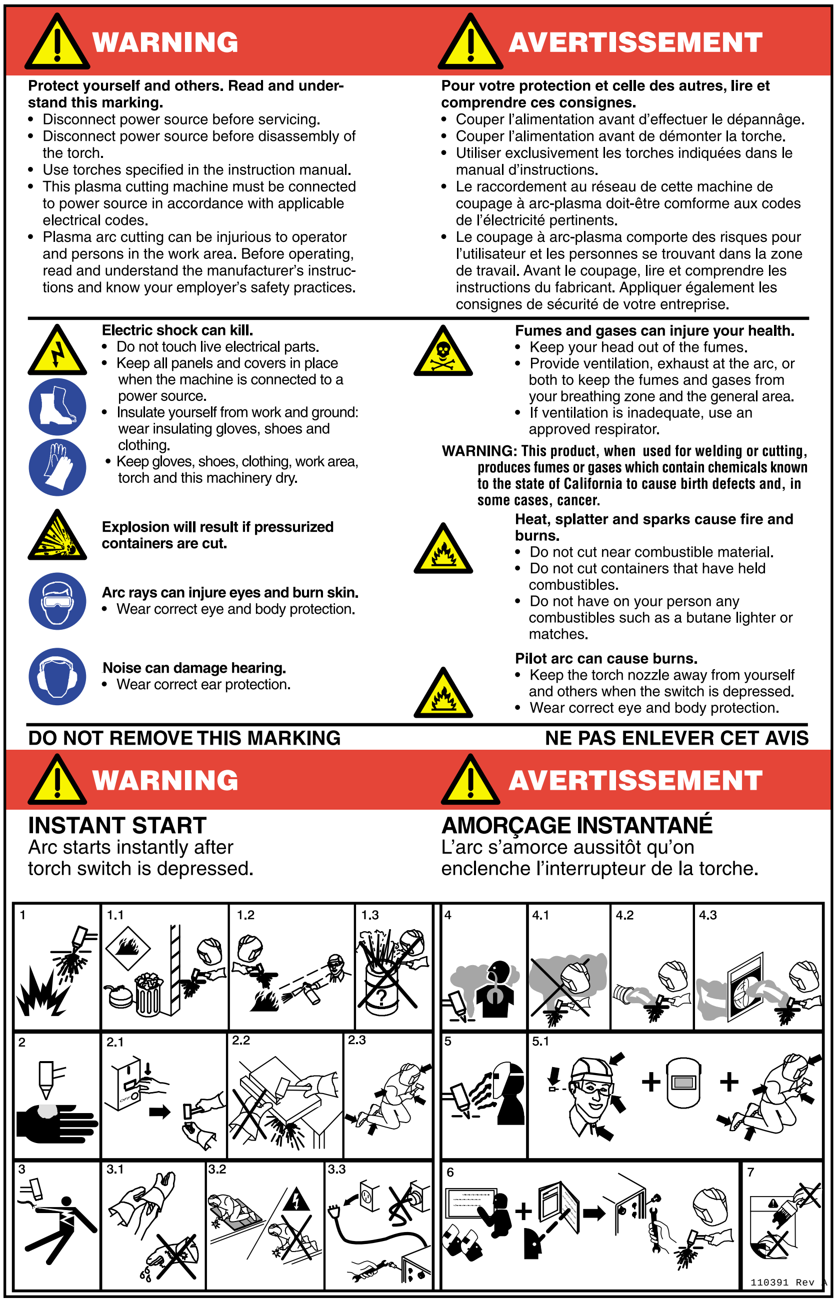
- Keep both the work cable and the torch lead to one side, away from your body.
- Route the torch leads as close as possible to the work cable.
- Do not wrap or drape the torch lead or work cable around your body.
- Keep as far away from the power supply as possible.

ADDITIONAL SAFETY INFORMATION

1. ANSI Standard Z49.1, *Safety in Welding and Cutting,* American Welding Society, 550 LeJeune Road P.O. Box 351020, Miami, FL 33135
2. ANSI Standard Z49.2, *Fire Prevention in the Use of Cutting and Welding Processes,* American National Standards Institute 1430 Broadway, New York, NY 10018
3. ANSI Standard Z87.1, *Safe Practices for Occupation and Educational Eye and Face Protection,* American National Standards Institute, 1430 Broadway, New York, NY 10018
4. AWS F4.1, *Recommended Safe Practices for the Preparation for Welding and Cutting of Containers and Piping That Have Held Hazardous Substances,* American Welding Society 550 LeJeune Road, P.O. Box 351040, Miami, FL 33135
5. AWS F5.2, *Recommended Safe Practices for Plasma Arc Cutting,* American Welding Society 550 LeJeune Road, P.O. Box 351040, Miami, FL 33135
6. CGA Pamphlet P-1, *Safe Handling of Compressed Gases in Cylinders,* Compressed Gas Association 1235 Jefferson Davis Highway, Arlington, VA 22202
7. CSA Standard W117.2, *Code for Safety in Welding and Cutting,* Canadian Standards Association Standard Sales 178 Rexdale Boulevard, Rexdale, Ontario M9W 1R3, Canada
8. NFPA Standard 51B, *Cutting and Welding Processes,* National Fire Protection Association 470 Atlantic Avenue, Boston, MA 02210
9. NFPA Standard 70–1978, *National Electrical Code,* National Fire Protection Association, 470 Atlantic Avenue, Boston, MA 02210
10. OSHA, *Safety and Health Standards,* 29FR 1910 U.S. Government Printing Office, Washington, D.C. 20402

WARNING LABEL

This warning label is affixed to some power supplies. It is important that the operator and maintenance technician understand the intent of these warning symbols as described. The numbered text corresponds to the numbered boxes on the label.



1. Cutting sparks can cause explosion or fire.

1.1 Keep flammables away from cutting.

1.2 Keep a fire extinguisher nearby, and have a watchperson ready to use it.

1.3 Do not cut on any closed containers.

2. The plasma arc can cause injury and burns.

2.1 Turn off power before disassembling torch.

2.2 Do not hold the material near cutting path.

2.3 Wear complete body protection.

3. Electric shock from torch or wiring can kill. Protect yourself from electric shock.

3.1 Wear insulating gloves. Do not wear wet or damaged gloves.

3.2 Insulate yourself from work and ground.

3.3 Disconnect input plug or power before working on machine.

4. Breathing cutting fumes can be hazardous to your health.

4.1 Keep your head out of the fumes.

4.2 Use forced ventilation or local exhaust to remove the fumes.

4.3 Use ventilating fan to remove the fumes.

5. Arc rays can burn eyes and injure skin.

5.1 Wear hat and safety glasses. Use ear protection and button shirt collar. Use welding helmet with correct shade of filter. Wear complete body protection.

6. Become trained and read the instructions before working on the machine or cutting.

7. Do not remove or paint over (cover) warning labels.

Hypertherm

Section 1

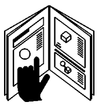
SÉCURITÉ

Dans cette section :



IDENTIFIER LES CONSIGNES DE SÉCURITÉ

Les symboles indiqués dans cette section sont utilisés pour identifier les risques éventuels. Si vous trouvez un symbole de sécurité, que ce soit dans ce manuel ou sur l'équipement, soyez conscient des risques de blessures et suivez les instructions correspondantes afin d'éviter ces risques.



SUIVRE LES INSTRUCTIONS DE SÉCURITÉ

Lire attentivement toutes les consignes de sécurité dans le présent manuel et sur les étiquettes de sécurité se trouvant sur la machine.

- Les étiquettes de sécurité doivent rester lisibles. Remplacer immédiatement les étiquettes manquantes ou abîmées.
- Apprendre à faire fonctionner la machine et à utiliser correctement les commandes. Ne laisser personne utiliser la machine sans connaître son fonctionnement.
- Garder la machine en bon état. Des modifications non autorisées sur la machine peuvent engendrer des problèmes de sécurité et raccourcir la durée d'utilisation de l'équipement.

DANGER   AVERTISSEMENT   PRÉCAUTION

Les signaux DANGER ou AVERTISSEMENT sont utilisés avec un symbole de sécurité, DANGER correspondant aux risques les plus sérieux.

- Les étiquettes de sécurité DANGER et AVERTISSEMENT sont situées sur la machine pour signaler certains dangers spécifiques.
- Les messages d'AVERTISSEMENT précèdent les instructions d'utilisation expliquées dans ce manuel et signalent les risques de blessures ou de mort au cas où ces instructions ne seraient pas suivies correctement.
- Les messages de PRÉCAUTION précèdent les instructions d'utilisation contenues dans ce manuel et signalent que le matériel risque d'être endommagé si les instructions ne sont pas suivies correctement.



LE COUPAGE PEUT PROVOQUER UN INCENDIE OU UNE EXPLOSION

Prévention des incendies

- Avant de commencer, s'assurer que la zone de coupage ne présente aucun danger. Conserver un extincteur à proximité.
- Éloigner toute matière inflammable à une distance d'au moins 10 m du poste de coupage.
- Tremper le métal chaud ou le laisser refroidir avant de le manipuler ou avant de le mettre en contact avec des matériaux combustibles.
- Ne jamais couper des récipients pouvant contenir des matières inflammables avant de les avoir vidés et nettoyés correctement.
- Aérer toute atmosphère potentiellement inflammable avant d'utiliser un système plasma.
- Lors de l'utilisation d'oxygène comme gaz plasma, un système de ventilation par aspiration est nécessaire.

Prévention des explosions

- Ne pas couper en présence de poussière ou de vapeurs.
- Ne pas couper de bouteilles, de tuyaux ou autres récipients fermés et pressurisés.
- Ne pas couper de récipients contenant des matières combustibles.



AVERTISSEMENT

Risque d'explosion
argon-hydrogène et méthane

L'hydrogène et le méthane sont des gaz inflammables et potentiellement explosifs. Conserver à l'écart de toute flamme les bouteilles et tuyaux contenant des mélanges à base d'hydrogène ou de méthane. Maintenir toute flamme et étincelle à l'écart de la torche lors de l'utilisation d'un plasma d'argon-hydrogène ou de méthane.



AVERTISSEMENT

Détonation de l'hydrogène lors du
coupage de l'aluminium

- Lors du coupage de l'aluminium sous l'eau, ou si l'eau touche la partie inférieure de la pièce d'aluminium, de l'hydrogène libre peut s'accumuler sous la pièce à couper et détonner lors du coupage plasma.
- Installer un collecteur d'aération au fond de la table à eau afin d'éliminer les risques de détonation de l'hydrogène. Se référer à l'annexe du manuel pour plus de renseignements sur les collecteurs d'aération.




LES CHOCS ÉLECTRIQUES PEUVENT ÊTRE FATALS

Toucher une pièce électrique sous tension peut provoquer un choc électrique fatal ou des brûlures graves.

- La mise en fonctionnement du système plasma ferme un circuit électrique entre la torche et la pièce à couper. La pièce à couper et tout autre élément en contact avec cette pièce font partie du circuit électrique.
- Ne jamais toucher le corps de la torche, la pièce à couper ou l'eau de la table à eau pendant le fonctionnement du système plasma.

Prévention des chocs électriques

Tous les systèmes plasma Hypertherm utilisent des hautes tensions pour le coupage (souvent de 200 à 400 V). On doit prendre les précautions suivantes quand on utilise le système plasma :

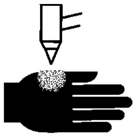
- Porter des bottes et des gants isolants et garder le corps et les vêtements au sec.
- Ne pas se tenir, s'asseoir ou se coucher sur une surface mouillée, ni la toucher quand on utilise le système plasma.
- S'isoler de la surface de travail et du sol en utilisant des tapis isolants secs ou des couvertures assez grandes pour éviter tout contact physique avec le travail ou le sol. S'il s'avère nécessaire de travailler dans ou près d'un endroit humide, procéder avec une extrême prudence.
- Installer un sectionneur avec fusibles appropriés, à proximité de la source de courant. Ce dispositif permet à l'opérateur d'arrêter rapidement la source de courant en cas d'urgence.
- En cas d'utilisation d'une table à eau, s'assurer que cette dernière est correctement mise à la terre.
- Installer et mettre à la terre l'équipement selon les instructions du présent manuel et conformément aux codes électriques locaux et nationaux.
- Inspecter fréquemment le cordon d'alimentation primaire pour s'assurer qu'il n'est ni endommagé, ni fendu. Remplacer immédiatement un cordon endommagé. **Un câble dénudé peut tuer**.
- Inspecter et remplacer les câbles de la torche qui sont usés ou endommagés.
- Ne pas saisir la pièce à couper ni les chutes lors du coupage. Laisser la pièce à couper en place ou sur la table de travail, le câble de retour connecté lors du coupage.
- Avant de vérifier, de nettoyer ou de remplacer les pièces de la torche, couper l'alimentation ou débrancher la prise de courant.
- Ne jamais contourner ou court-circuiter les verrouillages de sécurité.
- Avant d'enlever le capot du système ou de la source de courant, couper l'alimentation électrique. Attendre ensuite 5 minutes pour que les condensateurs se déchargent.
- Ne jamais faire fonctionner le système plasma sans que les capots de la source de courant ne soient en place. Les raccords exposés de la source de courant sont extrêmement dangereux.
- Lors de l'installation des connexions, attacher tout d'abord la prise de terre appropriée.
- Chaque système plasma Hypertherm est conçu pour être utilisé uniquement avec des torches Hypertherm spécifiques. Ne pas utiliser des torches inappropriées qui pourraient surchauffer et présenter des risques pour la sécurité.



LE COUPAGE PEUT PRODUIRE DES VAPEURS TOXIQUES

Le coupage peut produire des vapeurs et des gaz toxiques qui réduisent le niveau d'oxygène dans l'air et peuvent provoquer des blessures, voire la mort.

- Conserver le poste de coupage bien aéré ou utiliser un masque respiratoire homologué.
- Ne pas procéder au coupage près d'endroits où s'effectuent le dégraissage, le nettoyage ou la vaporisation. Certains solvants chlorés se décomposent sous l'effet des rayons ultraviolets et forment du phosgène.
- Ne pas couper des métaux peints ou contenant des matières toxiques comme le zinc (galvanisé), le plomb, le cadmium ou le béryllium, à moins que la zone de travail soit très bien ventilée et que l'opérateur porte un masque respiratoire. Les revêtements et métaux contenant ces matières peuvent produire des vapeurs toxiques lors du coupage.
- Ne jamais couper de récipients pouvant contenir des matières inflammables avant de les avoir vidés et nettoyés correctement.
- Quand on utilise ce produit pour le soudage ou le coupage, il dégage des fumées et des gaz qui contiennent des produits chimiques qui, selon l'État de Californie, provoquent des anomalies congénitales et, dans certains cas, le cancer.



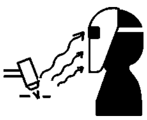
L'ARC PLASMA PEUT PROVOQUER DES BLESSURES OU DES BRÛLURES

Torches à allumage instantané

L'arc plasma s'allume immédiatement après que la torche soit mise en marche.

L'arc plasma coupe facilement les gants et la peau.

- Rester éloigné de l'extrémité de la torche.
- Ne pas tenir de métal près de la trajectoire de coupe.
- Ne jamais pointer la torche vers soi ou d'autres personnes.



LES RAYONS DE L'ARC PEUVENT BRÛLER LES YEUX ET LA PEAU

Protection des yeux Les rayons de l'arc plasma produisent de puissants rayons visibles ou invisibles (ultraviolets et infrarouges) qui peuvent brûler les yeux et la peau.

- Utiliser des lunettes de sécurité conformément aux codes locaux ou nationaux en vigueur.
- Porter des lunettes de protection (lunettes ou masque muni d'écrans latéraux ou encore masque de soudure) avec des verres teintés appropriés pour protéger les yeux des rayons ultraviolets et infrarouges de l'arc.



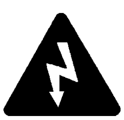
	Puissance des verres teintés	
Courant de l'arc	**AWS (É.-U.)**	**ISO 4850**
Jusqu'à 100 A	N° 8	N° 11
100-200 A	N° 10	N° 11-12
200-400 A	N° 12	N° 13
Plus de 400 A	N° 14	N° 14

Protection de la peau Porter des vêtements de sécurité pour se protéger contre les brûlures que peuvent causer les rayons ultraviolets, les étincelles et le métal brûlant :

- Gants à crispin, chaussures et casque de sécurité.
- Vêtements ignifuges couvrant toutes les parties exposées du corps.
- Pantalon sans revers pour éviter que des étincelles ou des scories puissent s'y loger.
- Avant le coupage, retirer de ses poches tout objet combustible comme les briquets au butane ou les allumettes.

Zone de coupage Préparer la zone de coupage afin de réduire la réverbération et la transmission de la lumière ultraviolette :

- Peindre les murs et autres surfaces de couleur sombre pour réduire la réflexion de la lumière.
- Utiliser des écrans et autres dispositifs de protection afin de protéger les autres personnes de la lumière et de la réverbération.
- Prévenir les autres personnes de ne pas regarder l'arc. Utiliser des affiches ou des panneaux.



MISE À LA MASSE ET À LA TERRE

Câble de retour Bien fixer le câble de retour (ou de masse) à la pièce à couper ou à la table de travail de façon à assurer un bon contact métal-métal. Ne pas fixer le câble de retour à la partie de la pièce qui doit se détacher.

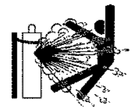
Table de travail Raccorder la table de travail à la terre, conformément aux codes de sécurité locaux ou nationaux appropriés.

Alimentation

- S'assurer que le fil de terre du cordon d'alimentation est connecté à la terre dans le coffret du sectionneur.
- S'il est nécessaire de brancher le cordon d'alimentation à la source de courant lors de l'installation du système, s'assurer que le fil de terre est correctement branché.
- Placer tout d'abord le fil de terre du cordon d'alimentation sur le plot de mise à la terre puis placer les autres fils de terre par-dessus. Bien serrer l'écrou de retenue.
- S'assurer que toutes les connexions sont bien serrées pour éviter la surchauffe.

SÉCURITÉ DES BOUTEILLES DE GAZ COMPRIMÉ

- Ne jamais lubrifier les robinets des bouteilles ou les régulateurs avec de l’huile ou de la graisse.
- Utiliser uniquement les bouteilles, régulateurs, tuyaux et accessoires appropriés et conçus pour chaque application spécifique.
- Entretenir l’équipement et les pièces d’équipement à gaz comprimé afin de les garder en bon état.
- Étiqueter et coder avec des couleurs tous les tuyaux de gaz afin d’identifier le type de gaz contenu dans chaque tuyau. Se référer aux codes locaux ou nationaux en vigueur.



LES BOUTEILLES DE GAZ COMPRIMÉ PEUVENT EXPLOSER EN CAS DE DOMMAGES

Les bouteilles de gaz contiennent du gaz à haute pression. Si une bouteille est endommagée, elle peut exploser.

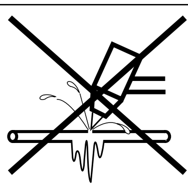
- Manipuler et utiliser les bouteilles de gaz comprimé conformément aux codes locaux ou nationaux.
- Ne jamais utiliser une bouteille qui n’est pas placée à la verticale et bien assujettie.
- Le capuchon de protection doit être placé sur le robinet sauf si la bouteille est en cours d’utilisation ou connectée pour utilisation.
- Éviter à tout prix le contact électrique entre l’arc plasma et une bouteille.
- Ne jamais exposer des bouteilles à une chaleur excessive, aux étincelles, aux scories ou aux flammes nues.
- Ne jamais utiliser des marteaux, des clés ou d’autres outils pour débloquer le robinet des bouteilles.



LE BRUIT PEUT PROVOQUER DES PROBLÈMES AUDITIFS

Une exposition prolongée au bruit du coupage ou du gougeage peut provoquer des problèmes auditifs.

- Utiliser un casque de protection homologué lors de l’utilisation du système plasma.
- Prévenir les personnes aux alentours des risques encourus en cas d’exposition au bruit.



UN ARC PLASMA PEUT ENDOMMAGER LES TUYAUX GELÉS

Les tuyaux gelés peuvent être endommagés ou éclater si l'on essaie de les dégeler avec une torche plasma.



PACEMAKERS ET PROTHÈSES AUDITIVES

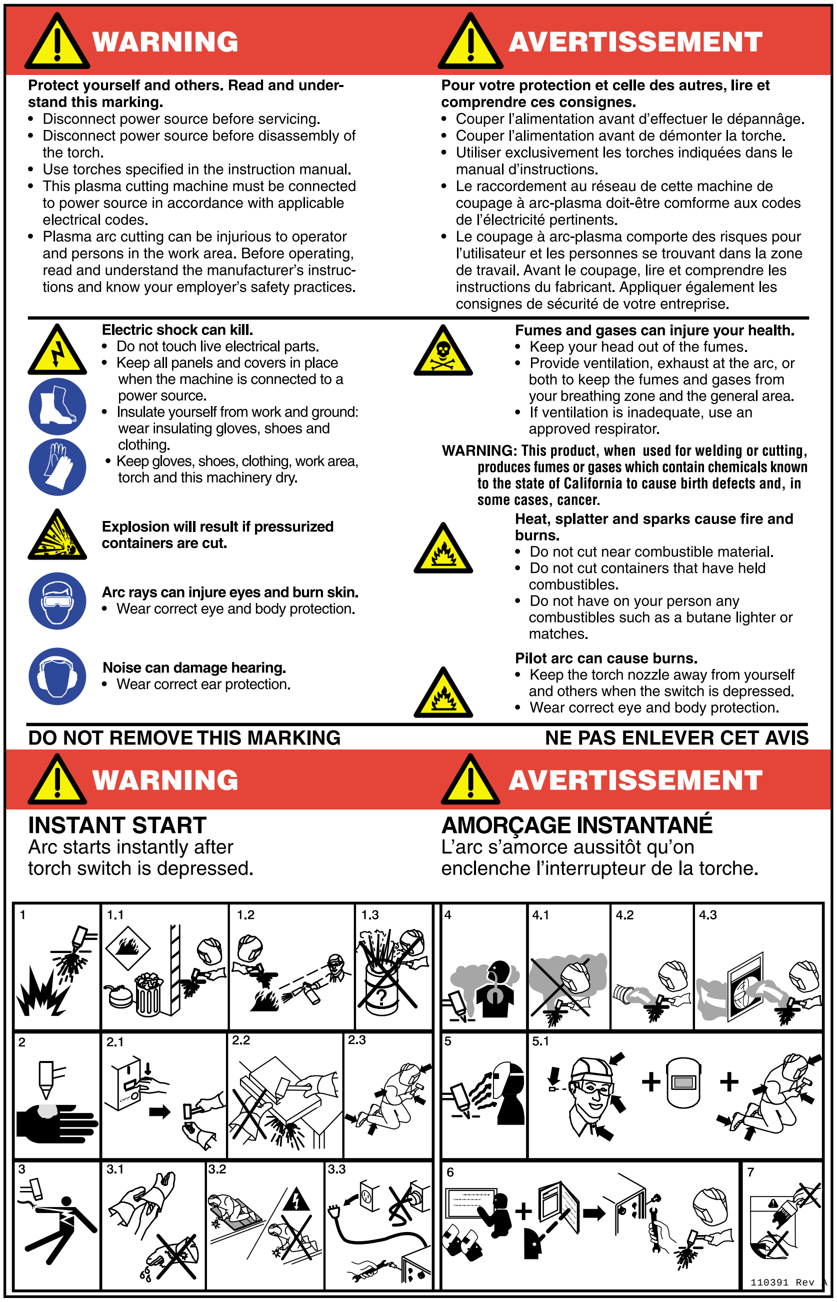
Les champs magnétiques produits par les courants à haute tension peuvent affecter le fonctionnement des prothèses auditives et des pacemakers. Les personnes portant ce type d’appareil doivent consulter un médecin avant de s’approcher d’un lieu où s’effectue le coupage ou le gougeage plasma.

Pour réduire les risques associés aux champs magnétiques :

- Garder loin de soi et du même côté du corps le câble de retour et le faisceau de la torche.
- Faire passer le faisceau de la torche le plus près possible du câble de retour.
- Ne pas s’enrouler le faisceau de la torche ou le câble de retour autour du corps.
- Se tenir le plus loin possible de la source de courant.

Étiquette de sécurité

Cette étiquette est affichée sur la source de courant. Il est important que l'utilisateur et le technicien de maintenance comprennent la signification des symboles de sécurité. Les numéros de la liste correspondent aux numéros des images.



1. Les étincelles produites par le coupage peuvent provoquer une explosion ou un incendie.
1.1 Pendant le coupage, éloigner toute matière inflammable.
1.2 Conserver un extincteur à proximité et s'assurer qu'une personne soit prête à l'utiliser.
1.3 Ne jamais couper de récipients fermés.
2. L'arc plasma peut provoquer des blessures et des brûlures.
2.1 Couper l'alimentation avant de démonter la torche.
2.2 Ne pas tenir la surface à couper près de la trajectoire de coupe.
2.3 Porter des vêtements de protection couvrant tout le corps.
3. Un choc électrique causé par la torche ou les câbles peut être fatal. Se protéger contre les risques de chocs électriques.
3.1 Porter des gants isolants. Ne pas porter de gants mouillés ou abîmés.
3.2 S'isoler de la surface de travail et du sol.
3.3 Débrancher la prise ou la source de courant avant de manipuler l'équipement.
4. L'inhalation des vapeurs produites par le coupage peut être dangereuse pour la santé.
4.1 Garder le visage à l'écart des vapeurs.
4.2 Utiliser un système de ventilation par aspiration ou d'échappement localisé pour dissiper les vapeurs.
4.3 Utiliser un ventilateur pour dissiper les vapeurs.
5. Les rayons de l'arc peuvent brûler les yeux et provoquer des lésions de la peau.
5.1 Porter un casque et des lunettes de sécurité. Se protéger les oreilles et porter une chemise dont le col peut être déboutonné. Porter un casque de soudure dont la protection filtrante est suffisante. Porter des vêtements protecteurs couvrant la totalité du corps.
6. Se former à la technique du coupage et lire les instructions avant de manipuler l'équipement ou de procéder au coupage.
7. Ne pas retirer ou peindre (recouvrir) les étiquettes de sécurité.

Section 2

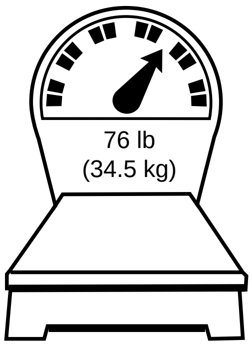
SPECIFICATIONS

In this section:

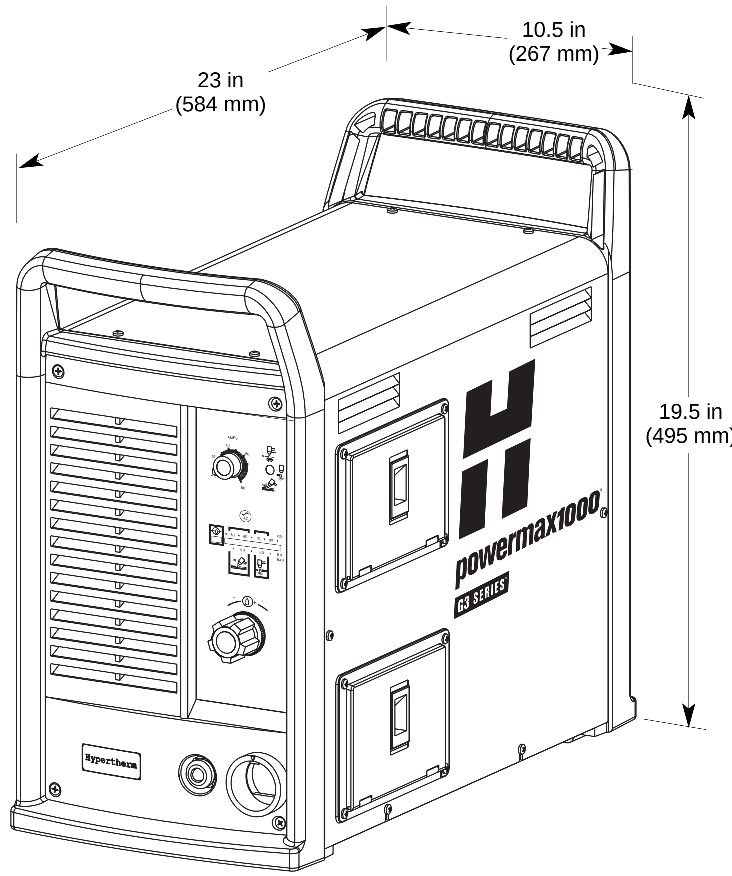
Specifications – Power Supply

Rated Open Circuit Voltage (U_0)	300 VDC		
OutputCharacteristic* *Defined as a plot of output voltage versus output current	Drooping		
Rated Output Current (I_2)	20A – 60A		
Hypertherm Standard Rated Output Voltage (U_2)	140 VDC		
Duty Cycle (X*) at 104°F (40°C) at rated conditions (U_1, I_1, U_2, I_2)	U_1 – Volts AC rms	X	
	200-208 VAC 1PH	40%	
	230-240 VAC 1PH	50%	
*X = T_{on}/T_{base},	480 VAC 1PH	50%	
T_{on} = time, minutes	200-208 VAC 3PH	40%	
T_{base} = 10 minutes	230-240 VAC 3PH	50%	
	380-400-415 VAC 3PH	50%	
	480 VAC 3PH	50%	
	600 VAC 3PH	50%	
Operating temperature	14° to 104° F (-10° to 40° C)		
Rated AC phases (PH) and line frequency (Hz)	PH	Hz	
Standard Model	1-3	50-60	
CE Model	3	50-60	
Rated Input Voltage (U_1), rated Input Current (I_1) and I_1eff* at rated Output U_2 and I_2 – cutting only.	U_1 – Volts AC rms	I_1-Amps rms	I_1eff
	200-208 VAC 1PH	50	32
	230-240 VAC 1PH	44	31
	480 VAC 1PH	22	15.5
	200-208 VAC 3PH	30	19
*I_1eff = (I_1) $\sqrt{X}$ used to determine rating of power cord.	230-240 VAC 3PH	26	18
	380-400-415 VAC 3PH	15	10.5
	480 VAC 3PH	12	8.5
	600 VAC 3PH	11	8
Power Factor	U_1 – Volts AC rms	Harmonic Power Factor	Displacement Power Factor
	200-208 VAC 1PH	0.99	0.99
	230-240 VAC 1PH	0.99	0.99
	480 VAC 1PH	0.91	0.99
	200-208 VAC 3PH	0.94	0.99
	230-240 VAC 3PH	0.94	0.99
	380-400-415 VAC 3PH	0.94	0.99
	480 VAC 3PH	0.94	0.99
	600 VAC 3PH	0.80	0.99
R_{sce} – Short Circuit Ratio—CE Model only	U_1 – Volts AC rms, 3PH	R_{sce}	
	400 VAC	153	
	230 VAC	97	
	This equipment conforms to IEC 61000-3-12, provided that $R_{sce\ min}$ = 153 at 400VAC 3PH and 97 at 230 VAC 3PH.		
IP code—Degree of protection provided by enclosure	IP23CS* IP – "International Protection" 2 – No ingress foreign objects ≧12.5mm (0.5 in) 3 – No harmful ingress spraying water C – AC line circuits protected against ingress of tool ≧2.5 mm dia. x 100 mm long (0.1 inch x 4.0 inch) S – fan stationary during water test *__WARNING: DO NOT OPERATE IN RAIN__*		
Toppling, Tilting (with or without wheel kit)	Up to 15° incline.		
Gas Type	Air	Nitrogen	
Gas Quality	Clean, moisture-free, oil-free		
Gas Inlet Pressure and Flow	See Section 3, Setup		

Power Supply – Dimensions and Weight



Weight of power supply without torch

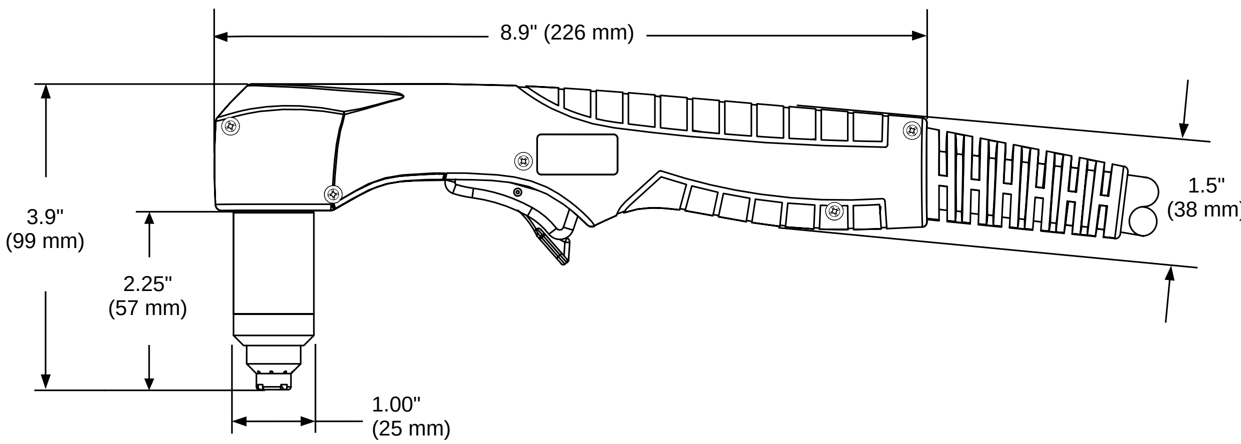


Specifications – T60 Torches

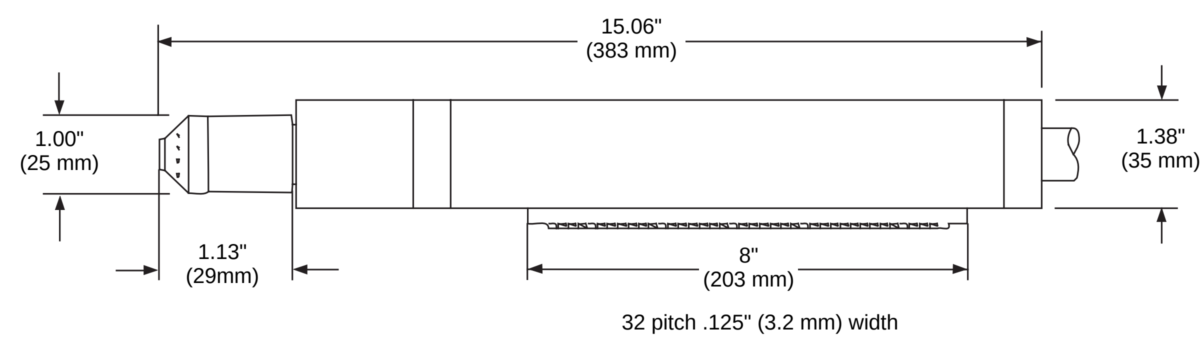
Cutting Capacity At 60 Amps	
Recommended capacity	3/4 inch (19 mm)
Maximum capacity	1 inch (25 mm)
Severance capacity	1-1/4 inch (32 mm)
Gouging Capability (metal removal rate on mild steel)	10.0 pounds (4.5 kg) / hour
Weight	
T60	6.9 pounds (3.1 kg) with 25 ft (7.5 m) lead 13.6 pounds (6.2 kg) with 50 ft (15 m) lead
T60M	4.5 pounds (2.0 kg) with 15 ft (4.5 m) lead 8.3 pounds (3.8 kg) with 25 ft (7.5 m) lead 9.9 pounds (4.5 kg) with 35 ft (10.7 m) lead 15.0 pounds (6.8 kg) with 50 ft (15 m) lead

Torch Dimensions

T60 Hand Torch Dimensions



T60M Machine Torch Dimensions



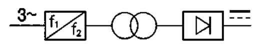
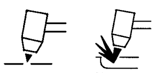
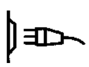
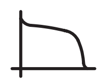
Symbols and Markings

S MARK

The S mark indicates that the power supply and torch are suitable for use in environments with increased hazard of electrical shock. The hand torches must have shielded consumable parts to maintain S mark compliance.

IEC Symbols Used

The following symbols may appear on the power supply data plate, control labels and switches.

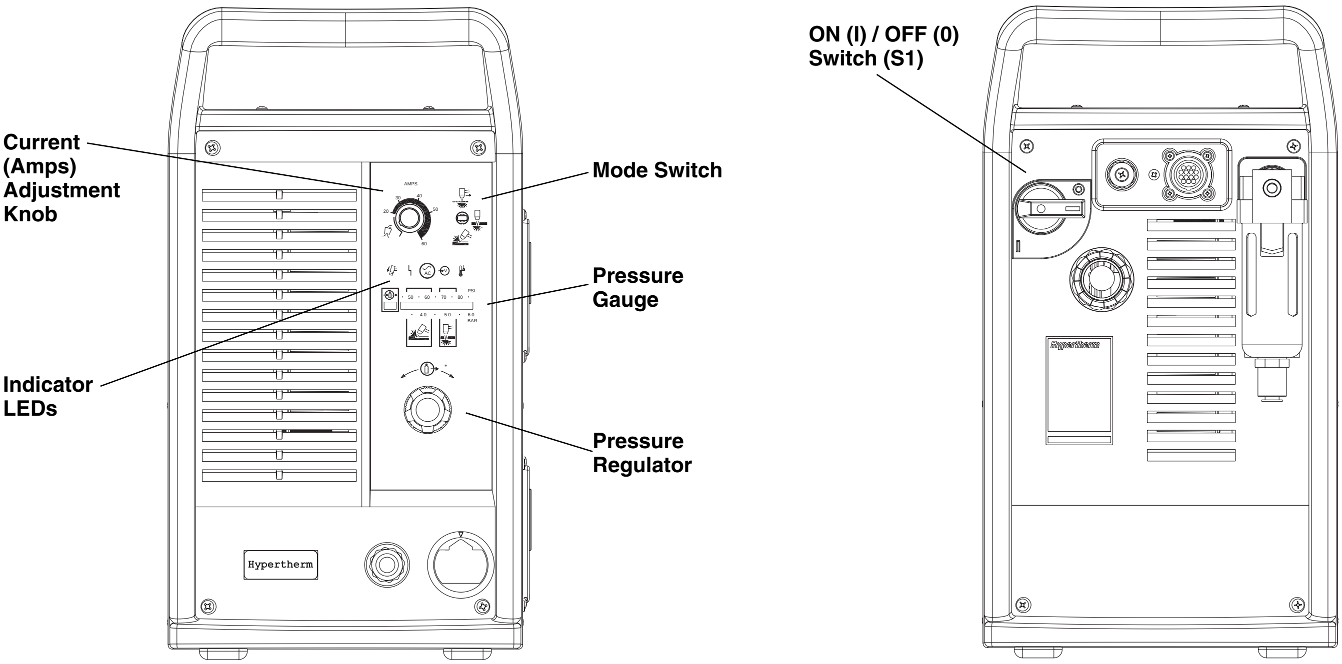
	Direct Current (DC)		An inverter-based power source
	Alternating current (AC)		Plasma torch in the TEST position (cooling and cutting gas exiting nozzle)
	Plasma torch cutting and gouging	I	Power is on
	AC input power connection	O	Power is off
	The terminal for the external protective (earth) conductor		Volt/amp curve, "drooping" characteristic

Section 3

MAINTENANCE

In this section:

Controls and Indicators



Indicator LEDs

Green Power ON LED
When illuminated, indicates that power is applied to system and power switch is ON (I).

Gas Pressure LED
Yellow: When flashing, indicates that the gas pressure is below 60 psig (4.1 bar) for cutting, or 40 psig (2.8 bar) for gouging.
Green: When illuminated, indicates acceptable gas pressure for torch operation.

Yellow Torch Cap LED
When illuminated, indicates that the retaining cap is loose or not installed.
NOTE: Turn power OFF, correct this fault condition, then turn power ON to extinguish LED.

Yellow Temp LED
When illuminated, indicates that the power supply temperature is too hot.

Red Fault LED
When illuminated, indicates that a fault condition exists, which prevents system operation.

Yellow Low Line Voltage LED
When illuminated, indicates that line voltage is below 170 VAC or above 680 VAC. On CE units, it can also indicate a missing phase.

Theory of Operation

General

Refer to Functional Description, Sequence of Operation and the system wiring diagram in Section 6.

Functional Description

AC power enters the system through the power switch S1 to the input diode bridge D24. The voltage from the diode bridge supplies the Power Factor Correction (PFC) Boost Converter which provides a 750 VDC bus voltage. The bus voltage then supplies the inverter and the flyback system power supply (DC to DC converter) on the power board PCB2. The power board provides noise suppression and spike protection. A "soft start" is implemented via the power board resistor and relay K1.

The PFC Boost Converter consists of an isolated gate bipolar transistor (IGBT) Q7, choke and control circuit. It provides a 750 VDC bus voltage when input AC voltage is between 170 and 540 VAC. When the input voltage is above 540 VAC the bus voltage will rise to $Vin*\sqrt{2}$.

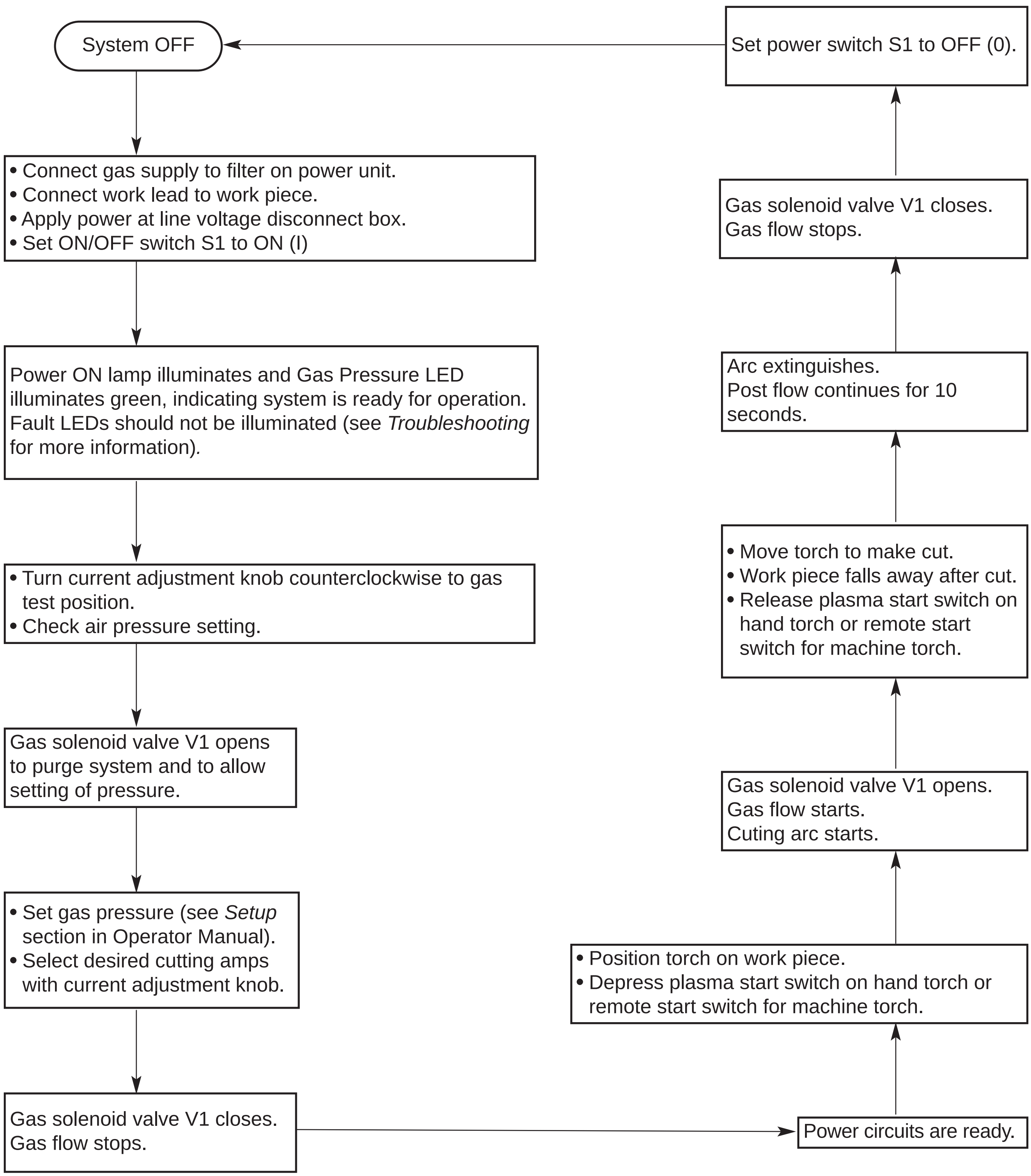
The inverter consists of an IGBT Q6, the power transformer T2, a current sense transformer, and sections of the power board. The inverter operates as a pulse-width, modulator-controlled bridge circuit, and is rectified by the output diode.

The output circuitry consists of 2 current transfer sensors located on the power board, the pilot arc IGBT Q8 and the output choke.

The control board's microprocessor monitors and regulates system operation and safety circuits. The current is set to the desired value by adjusting the current adjustment knob. The system compares the set point to the output current by monitoring the current sensor and adjusting the pulse width output of the inverter IGBT Q6.

The control board PCB3 includes a pilot arc control switch, allowing the operator to turn the pilot arc ON (useful when cutting expanded metal), OFF (for maximum life of consumables), or increase the pilot arc to 20A (useful for gouging or non-transferred-arc cutting).

Sequence of Operation



TROUBLESHOOTING

The complexity of the circuits requires that service technicians have a working knowledge of inverter power supply theory. In addition to being technically qualified, technicians must perform all testing with safety in mind.

If questions or problems arise during servicing, call the nearest Hypertherm Technical Services Department listed in the front of this manual.

Test Equipment

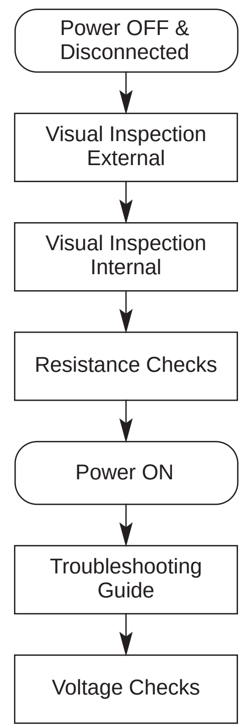
- Multimeter

Troubleshooting Procedures and Sequence

When performing the troubleshooting procedures,

- Refer to *Section 6* for the system wiring diagram;
- Refer to *Section 4* to locate power supply components;
- Refer to *Section 5* for torch components.

After the problem has been located and repaired, refer to the *Sequence of Operation* flow diagram in this section to test the power supply for proper operation.



Visual Inspection – External

1. Inspect the outside of the power supply for damage to the cover and external components.
2. Inspect the torch and the torch lead for damage.

WARNING

ELECTRIC SHOCK CAN KILL

- **Turn off the power and remove the input power plug from its receptacle before removing the cover from the power supply. If the power supply is directly connected to a line disconnect box, switch the line disconnect to OFF (O). In the U.S., use a "lock-out / tag-out" procedure until the service or maintenance work is complete. In other countries, follow appropriate national or local safety procedures.**
- **Do not touch live electrical parts! If power is required for servicing, use extreme caution when working near live electrical circuits. Dangerous voltages exist inside the power supply that can cause serious injury or death.**
- **Do not attempt to repair the power board or control board. Do not cut away or remove any protective conformal coating from either board. To do so will risk a short circuit between the AC input circuit and the output circuit and may result serious injury or death.**

HOT PARTS CAN CAUSE SEVERE BURNS

- **Allow the power supply to cool before servicing.**

MOVING BLADES CAN CAUSE INJURY

- **Keep hands away from moving parts.**

STATIC ELECTRICITY CAN DAMAGE CIRCUIT BOARDS

- **Put on a grounded wrist strap before handling PC boards.**

Visual Inspection – Internal

1. Set the ON/OFF switch S1 to O (OFF), unplug the power cord and disconnect the gas supply.
2. Remove the cover of the power supply by removing the 12 securing screws.
3. Inspect the inside of the power supply, especially on the side with the power board. Look for broken or loose wiring connections, burn and char marks, damaged components, etc. Repair or replace as necessary.

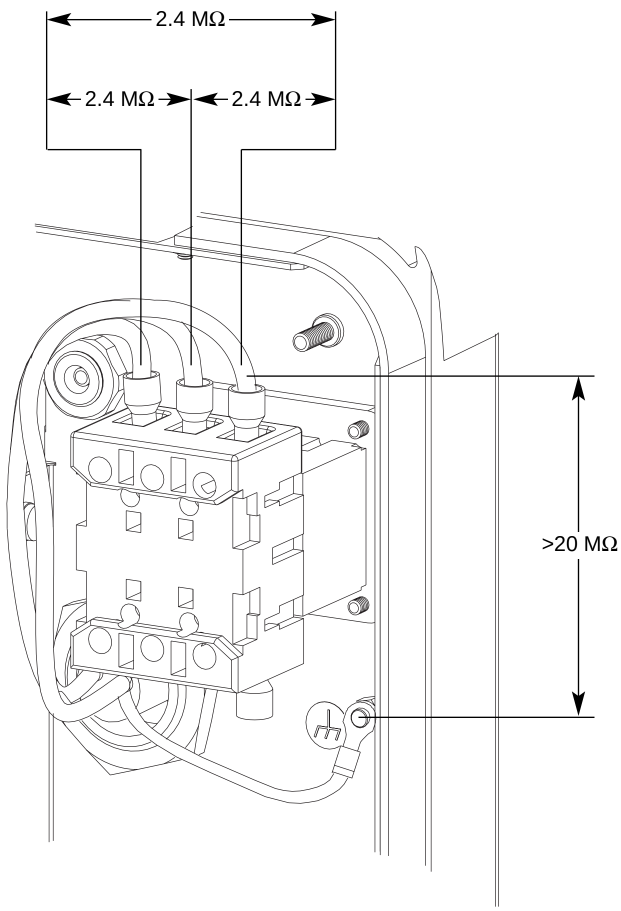
Resistance Checks

All resistance values must be taken with the power cord disconnected and all internal power supply wires attached. Perform Visual Inspection – Internal before continuing in this section.

- If resistance values are not close to the values given in this section, isolate the problem by removing wires attached to the resistance check points or component until the problem is found.
- After the problem has been located and repaired, refer to the *Sequence of Operation* flow diagram in this section to test the power unit for proper operation.

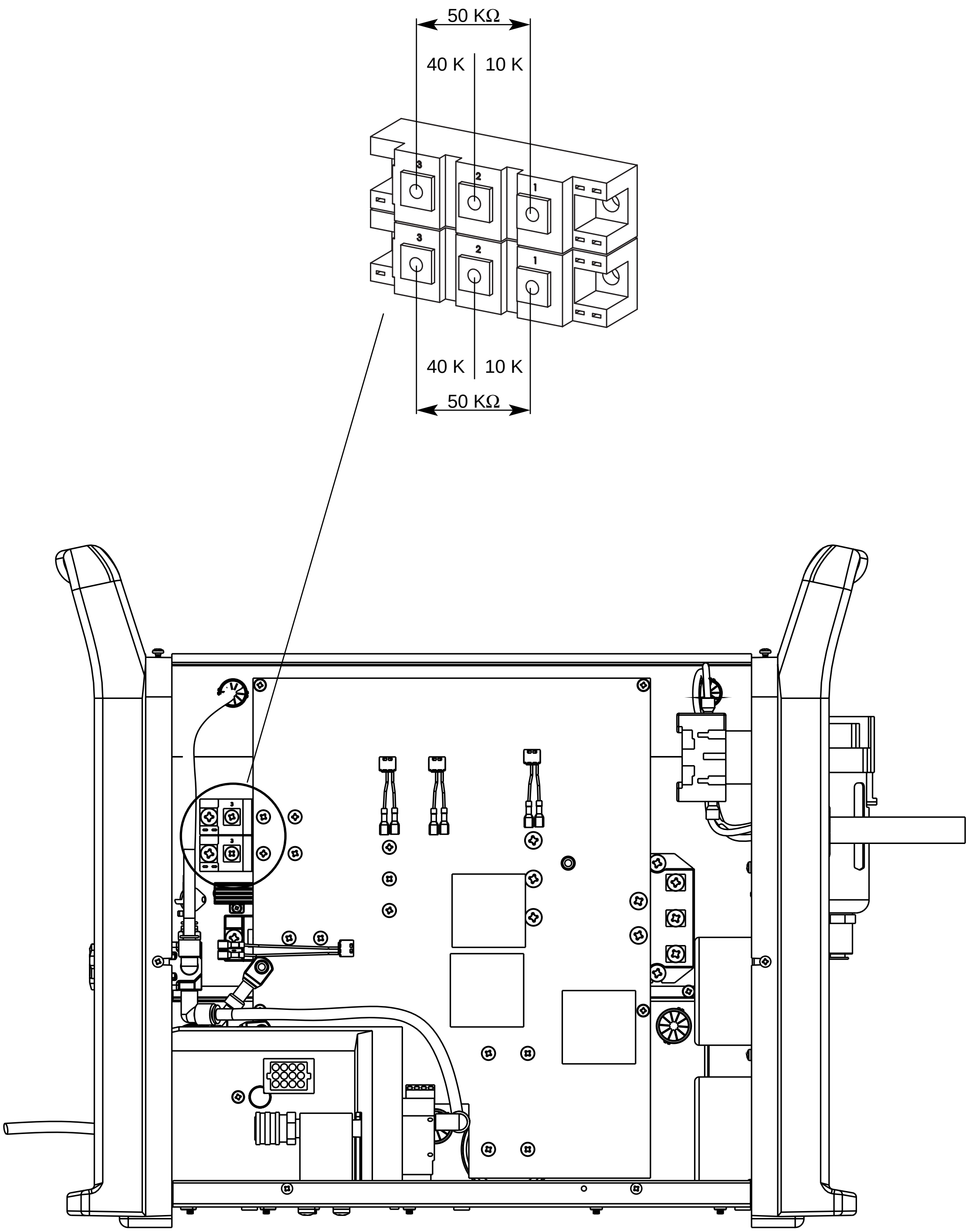
Resistance Check #1

1. With the power disconnected, set the ON/OFF switch S1 to ON.
2. Check resistance across input leads.
3. Check resistance from input leads to ground.



Resistance Check #2

- Check resistance across output diode bridge.



Troubleshooting Guide

WARNING

ELECTRIC SHOCK CAN KILL

- **Use extreme caution when working near live electrical circuits. Dangerous voltages exist inside the power supply that can cause serious injury or death.**
- **See warnings on page 3-7 before proceeding.**

If no problems were found during the initial resistance checks and the power supply still does not operate correctly, see the *Troubleshooting Guide* on the following pages.

Note: The *Troubleshooting Guide* provides most probable causes and solutions. Study the system wiring diagram and understand the theory of operation before troubleshooting. Before purchasing a major replacement component, verify the problem with Hypertherm Technical Service or the nearest Hypertherm repair facility.

Problem	This May Mean	Cause	Solution
Turn power switch ON and Power On LED does not illuminate	Insufficient voltage to control circuits or shorted power component	No voltage or improper voltage applied to unit	Verify incoming voltage is between 200-600 VAC.
		Defective power switch (S1)	Measure AC voltage at bottom terminals of switch. If no voltage, replace switch.
		Defective filter board (PCB1)	**CE System only:** Measure AC voltage at input diode bridge. If no voltage or low voltage, replace filter board.
		Defective input diode bridge (D24)	Measure DC voltage on input diode bridge. Voltage at input diode bridge should be approximately Vin * $\sqrt{2}$. If incorrect voltage or no voltage, replace input diode bridge.
		Defective power board (PCB2) or IGBT module (Q7)	Bus voltage should be 750 VDC when input voltage is between 200-540 VAC. If voltage is incorrect, inspect power board and IGBT module for damage.
		Defective power board (PCB2) or control board (PCB3)	Disconnect power board J4 connector and measure for VDC on power board TP1: J4-Pin16 = 5 VDC, J4-Pin18 = 5 VDC with start switch depressed. If incorrect voltage or no voltage, replace power board. If voltage is correct, replace control board.
Red LED on power board (PCB2) illuminates when input voltage is between 200-540 VAC		Defective boost IGBT module (Q7) or power board (PCB2)	Replace boost IGBT (Q7) and inspect power board (PCB2) for damage.
Power LED illuminates and air flows from torch (torch trigger/start switch not pressed)	System is in gas test mode	Current adjustment knob is in gas test position	Turn knob clockwise until above the 20 amp setting.
	Solenoid valve (V1) stuck open	Faulty valve	Disconnect J20 from power board (PCB2). If air flow continues, replace valve (V1).
	Defective power board (PCB2)	Constant voltage supplied to valve	Disconnect J20 from power board (PCB2). If air flow stops, replace power board.
Voltage LED illuminates	Improper line voltage	Voltage below proper operating limits or loss of phase	Verify incoming line voltage.
Air pressure LED blinks yellow	Insufficient air pressure	No air supplied to unit	Connect air supply.
		Air pressure below operating requirement	Turn current adjustment knob to gas test and set pressure to 70 psi (4.8 bar) for cutting and 50 (3.4 bar) for gouging is required for system operation. Check that the inlet gas pressure is within setup specifications in section 2.
		Faulty pressure sensor assembly	With normal air supply (>90 psi) connected, measure R50 left to TP1 with a DC digital voltage meter. Voltage should be approximately 3.3V when regulator is set at 70 psi. Change regulator setting and verify that voltage also changes.
		Dirty air filter element	Replace air filter element.

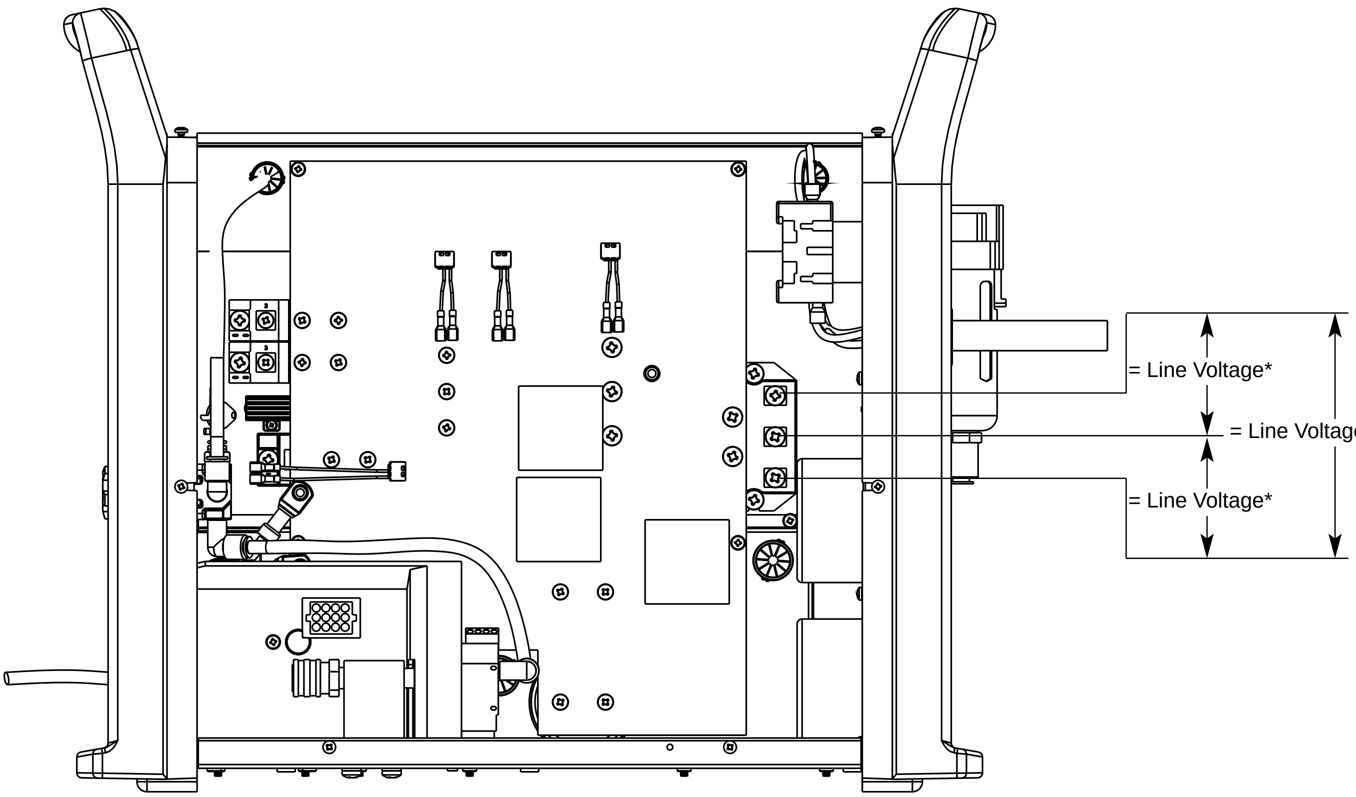
Problem	This May Mean	Cause	Solution
Yellow cap sensing LED illuminates	Safety circuit not satisfied	Consumables not installed, installed improperly, or damaged	Refer to consumable diagram for proper installation. Try new consumables.
		Damage to safety circuit	Remove torch. Check torch end of connector. Install consumables and check continuity on J18, pins 11 and 12 orange and blue wires. If open circuit, inspect torch
Over temp LED illuminates	Temperature sensors not satisfied	Exceeded duty cycle	Allow unit to cool. Stay with duty cycle limits in manual.
		Fan not operating or improperly operating	Disconnect J2 and jump pins 1 and 2. Fan should operate.
		Defective heatsink temperature switch TP1 (check when system is cool, at least 15 min after use)	Remove J2 from power board (PCB2). Check temperature PCB (PCB4) by checking resistance on pins 1 and 2. If resistance is not between 3k-5k ohms, replace temperature sensor PCB (PCB4).
		Defective power transformer (T2) temperature sensor TS2 (check when system is cool, at least 60 min after use)	Check transformer sensor (T2) by checking resistance on J21 pins 1 and 2 on wires. If greater than 15 k ohms, replace power transformer.
Power LED illuminates, all fault LEDs extinguished, but no air flow or firing of torch when torch switch is pressed	Start signal not being received by power supply. Start LED off on control board (PCB3).	Damage to torch and lead assembly.	Remove torch. Check J18 pins 10 and 12 violet and orange wires for continuity when torch trigger is depressed. If open circuit, inspect torch and lead assembly.
AC	Solenoid valve not working	Valve stuck or no voltage to valve	Check voltage at valve. Remove connector J21 from valve, turn current adjust knob to test flow and check for 24 VDC at connector J21 pins 1 and 3. If no voltage, replace power board. If voltage, clear air lines or replace valve.
	Damaged torch or lead assembly	Torch plunger stuck open or broken torch leads	Verify fault: control board (PCB3) TSO LED illuminated. Inspect torch and lead assembly.
	Damaged control board (PCB3)	Defective control board	Replace board.
When pressing torch trigger/start switch, air flows from torch, but no arc	Worn or bad consumables	Overuse or improperly installed consumables	Replace consumables.
	Insufficient air flow	Improper pressure setting	Turn current adjustment knob to test flow and set pressure regulator 70 psi (4.7 bar) for cutting and 50 psi (3.4 bar) for gouging.
	No output from power board (PCB2)	Power board failure, or damaged torch or lead assembly.	Verify fault: control board (PCB3) IF LED. If Fault and IF LEDs are illuminated, replace power board. If IF LED is not illuminated, replace torch and lead assembly. NOTE: OCV is 300VDC but is only available for 100 msec. Measure at J15 and J16 using a Fluke 87 or equivalent digital multi-meter.

Problem	This May Mean	Cause	Solution
When pressing torch trigger/start switch, pilot arc starts but “pops out” before the normal 5 second time-out period	Worn consumables	Worn-out consumables	Replace consumables
	Improper air pressure setting or low flow	Insufficient supply or air leak on supply line	Turn current adjust knob to test flow and set pressure regulator to 70 psi (4.7 bar) for cutting or 50 psi (3.4 bar) for gouging. If unable to adjust to proper setting, check external air supply.
	Poor quality air	Moisture or contaminates in air supply	Add appropriate filtration and purge lines with nitrogen to flush out oil and moisture.
	Insufficient input power	Undersized electrical supply installation: - Breaker/fuse - Supply wire	Verify external electrical power is installed per specifications in section 2. Check input voltage while trying to fire torch. Voltage drop indicates undersized electrical supply installation.
	Inverter fault or interlock	Power board (PCB2) failure	If the control board (PCB2) IF LED illuminates and one or more of the fault LEDs illuminate, then the fault is caused by the parameter monitored by the fault LED. If no fault LED is illuminated, replace power board.
Machine will not cut material (does not appear to be operating at full cutting power)	Inadequate ground	Poor work lead connection	Verify work lead is attached to workpiece and workpiece is free of rust, paint, etc.
		Damaged work lead	Check continuity of work lead. Replace or repair as required.
		Defective pilot arc IGBT (Q8)	Turn power OFF, remove consumables, check resistance between plunger and work piece. If resistance is greater than 8k ohms. Inspect work lead. Check pilot arc IGBT resistance between two screws at Q8 on power board. If resistance is less than 5k ohms, replace pilot arc IGBT.
	Low output from power supply	Current adjustment set too low	Verify current adjust knob is at proper setting (turn to max, full clockwise).
		Defective power board current sensor	Replace power board. Can confirm power output by measuring with a DC current clamp meter on work lead.
Losing pilot arc when going off plate while in continuous pilot mode	Continous pilot arc does not work.	Mode switch set wrong	Set mode switch to correct position.
		Faulty control board (PCB3)	Replace control board.

Voltage Checks

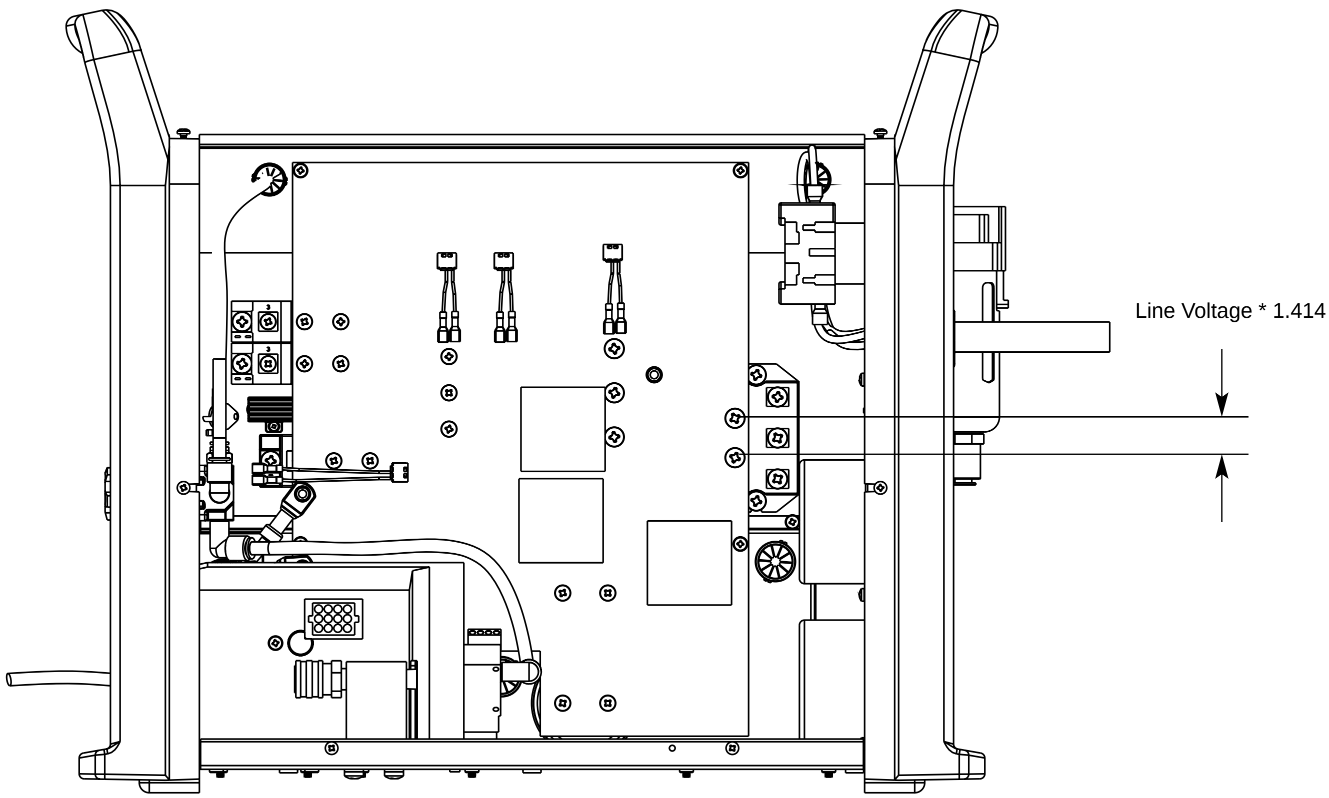
Voltage Check #1

- This voltage check only applies to 3-phase.
- Check input voltage to the input diode bridge.
- The AC voltage between any 2 input wires should equal the line voltage.



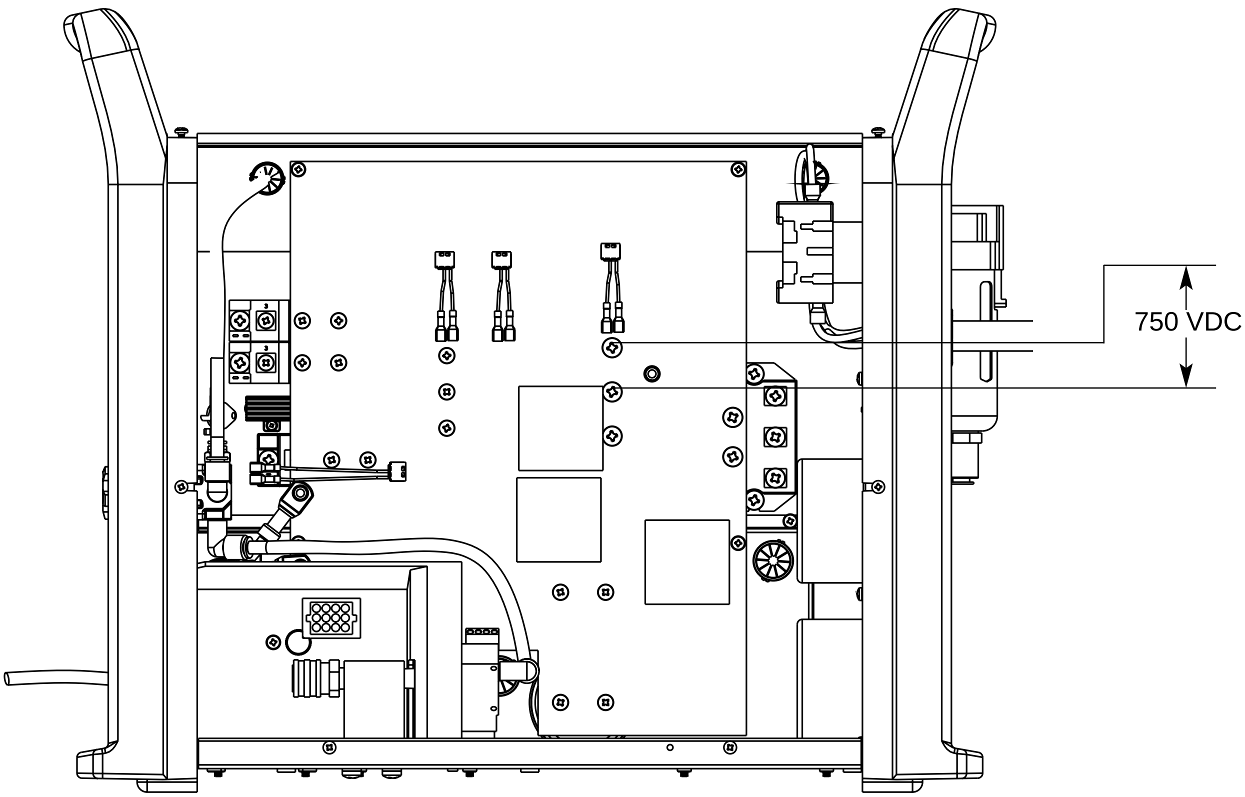
Voltage Check #2

- Check output voltage of the input diode bridge.
- Output VDC = Line Voltage * 1.414



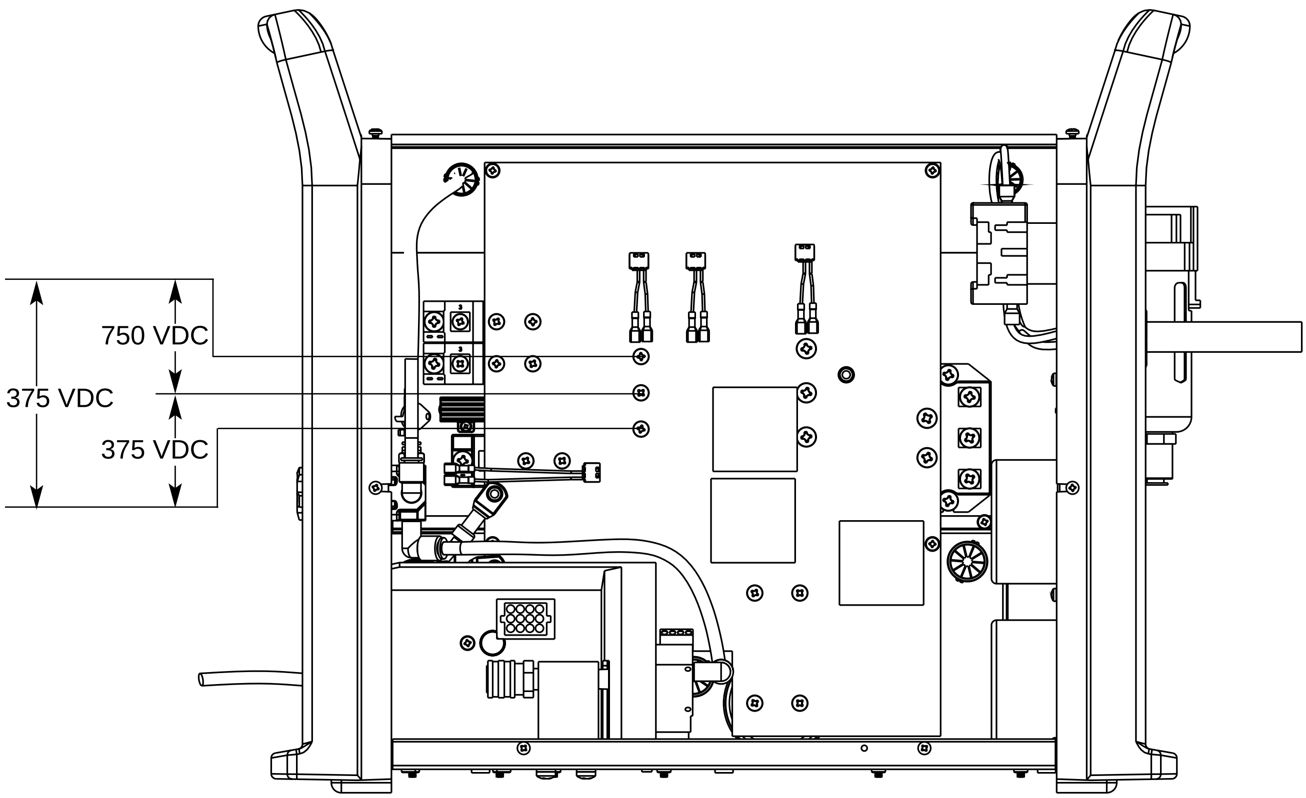
Voltage Check #3

- Check voltage across IGBT module (Q7).



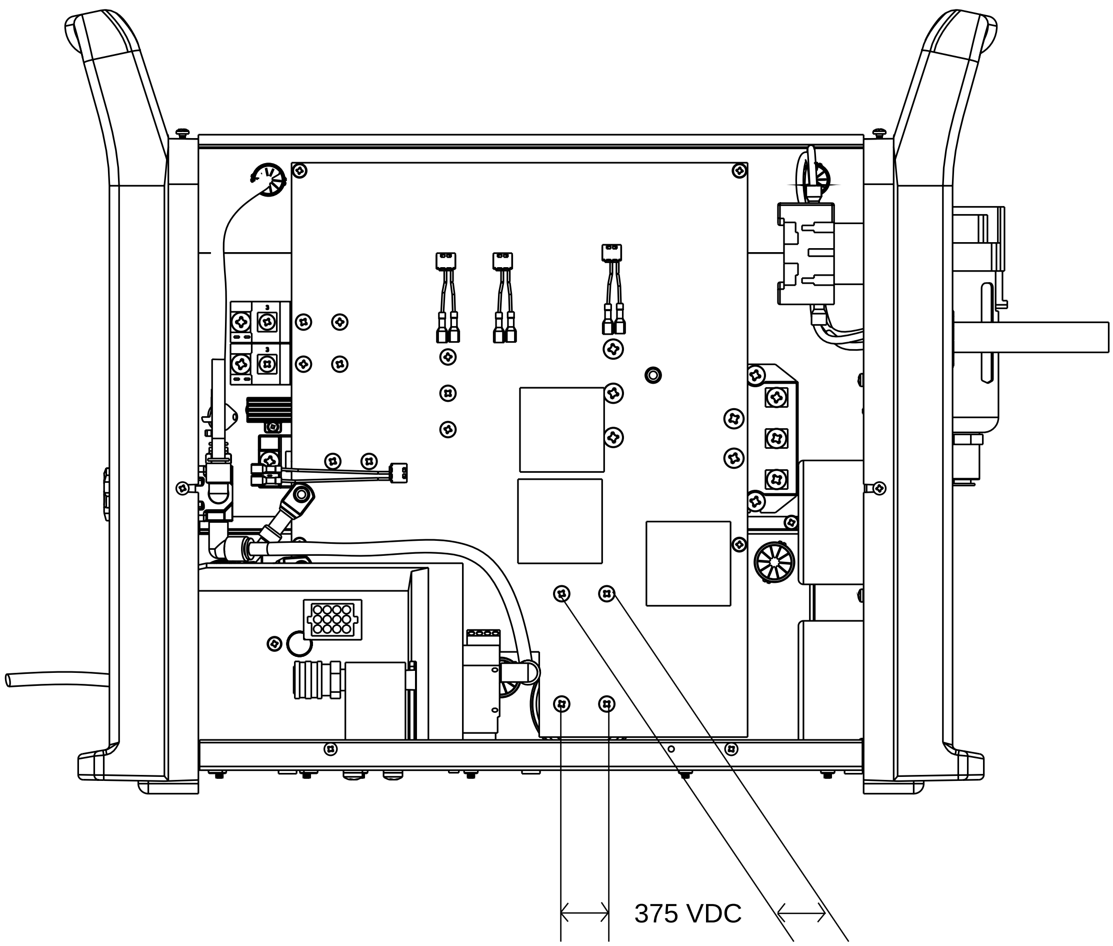
Voltage Check #4

- Check voltage across IGBT module (Q6).



Voltage Check #5

- Check voltage across power supply capacitors.



Component Replacement



WARNING



ELECTRIC SHOCK CAN KILL

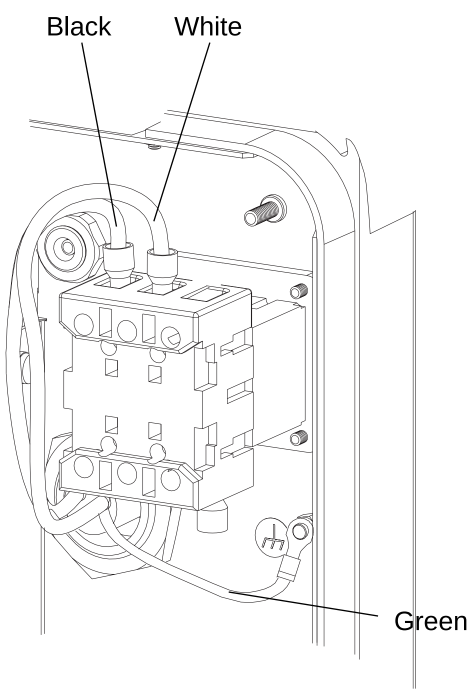
- **Use extreme caution when working near live electrical circuits. Dangerous voltages exist inside the power supply that can cause serious injury or death.**
- **See warnings on page 3-7 before proceeding.**

Power Cord Replacement

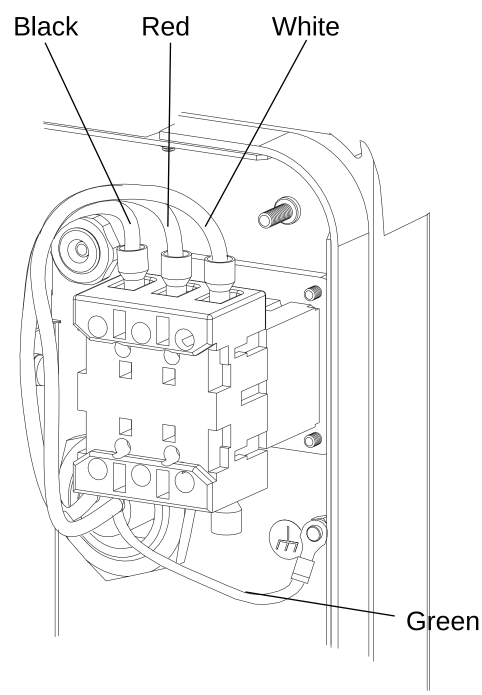
Disconnect electrical power and gas supply before removing the old power cord.

Installation – See figures below.

1. Insert the new power cord through the strain relief.
2. Install the power cord connections where shown.
3. Tighten the strain relief onto the power cord.
4. Install the power supply cover.
5. Reconnect electrical power and gas supply.



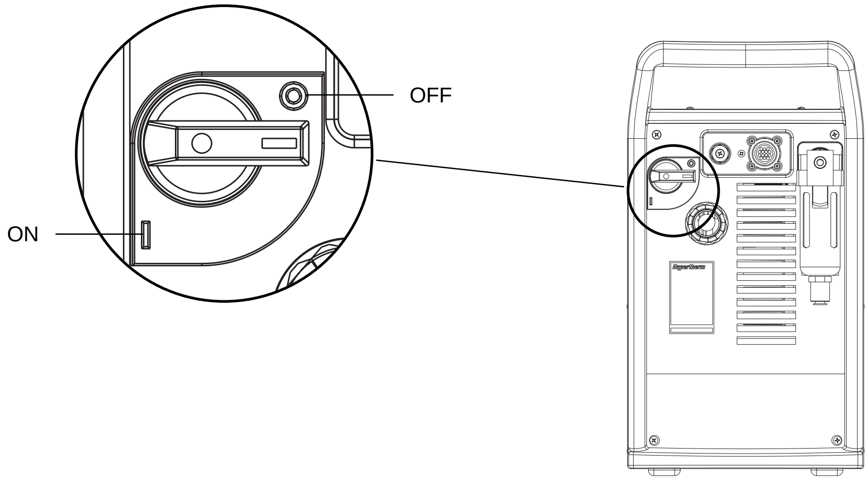
Single Phase



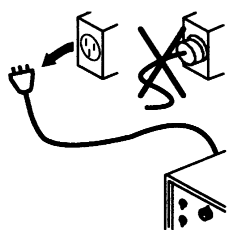
Three Phase

Torch Installation

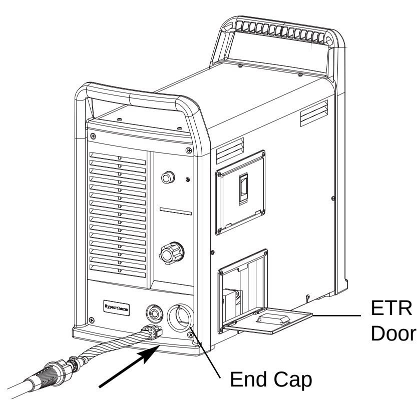
① Turn power OFF.



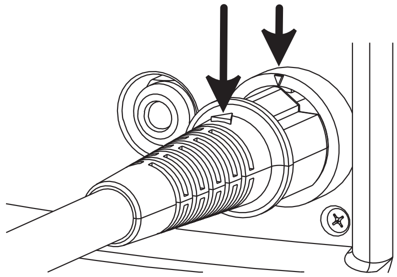
② Remove power cord from power receptacle.



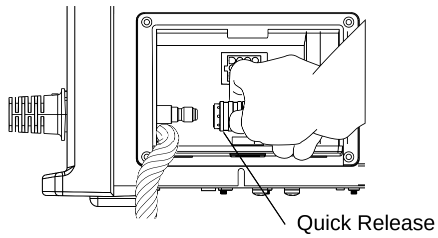
③ Open ETR door and route the lead through the end cap.



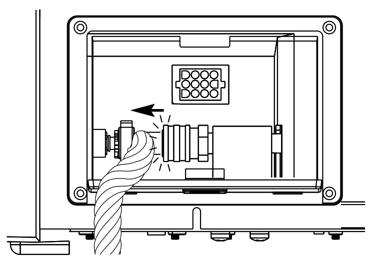
④ Align marks on strain relief.



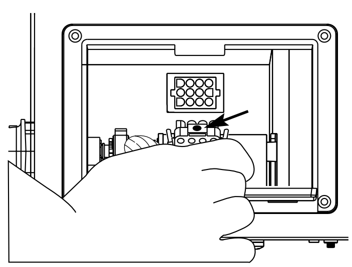
⑤ Pull back quick-release collar and insert the lead's gas fitting.



⑥ Slide quick-release collar foward to lock in the gas fitting. Make sure that the gas fitting is secure.

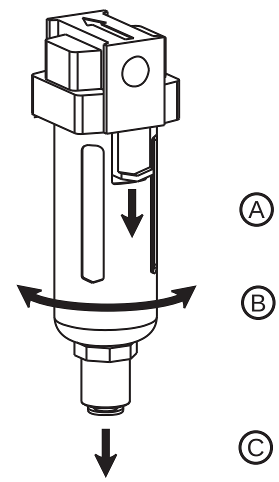


⑦ Make sure that the red dot on the connector is on top, then plug in the electrical connector. Close ETR door.

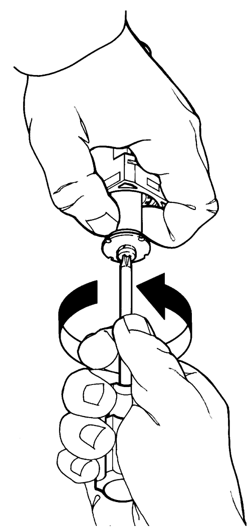


Filter Element Replacement

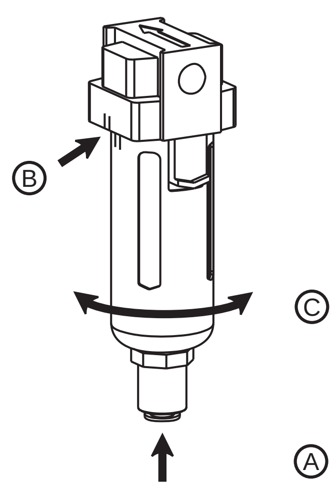
① Disconnect electrical power and gas supply.
Remove filter bowl on new and old filter.
A. Pull down black release tab and hold.
B. Rotate filter bowl until it is released.
C. Pull filter bowl down to remove. Do not discard the O-ring.



② Remove the filter element from the filter housing.
NOTE: Do not allow the filter element to turn when loosening the screw.



③ Install filter bowl.
A. Slide filter bowl over filter element.
B. Align marks on filter bowl and filter body.
C. Rotate filter bowl until it locks in place.



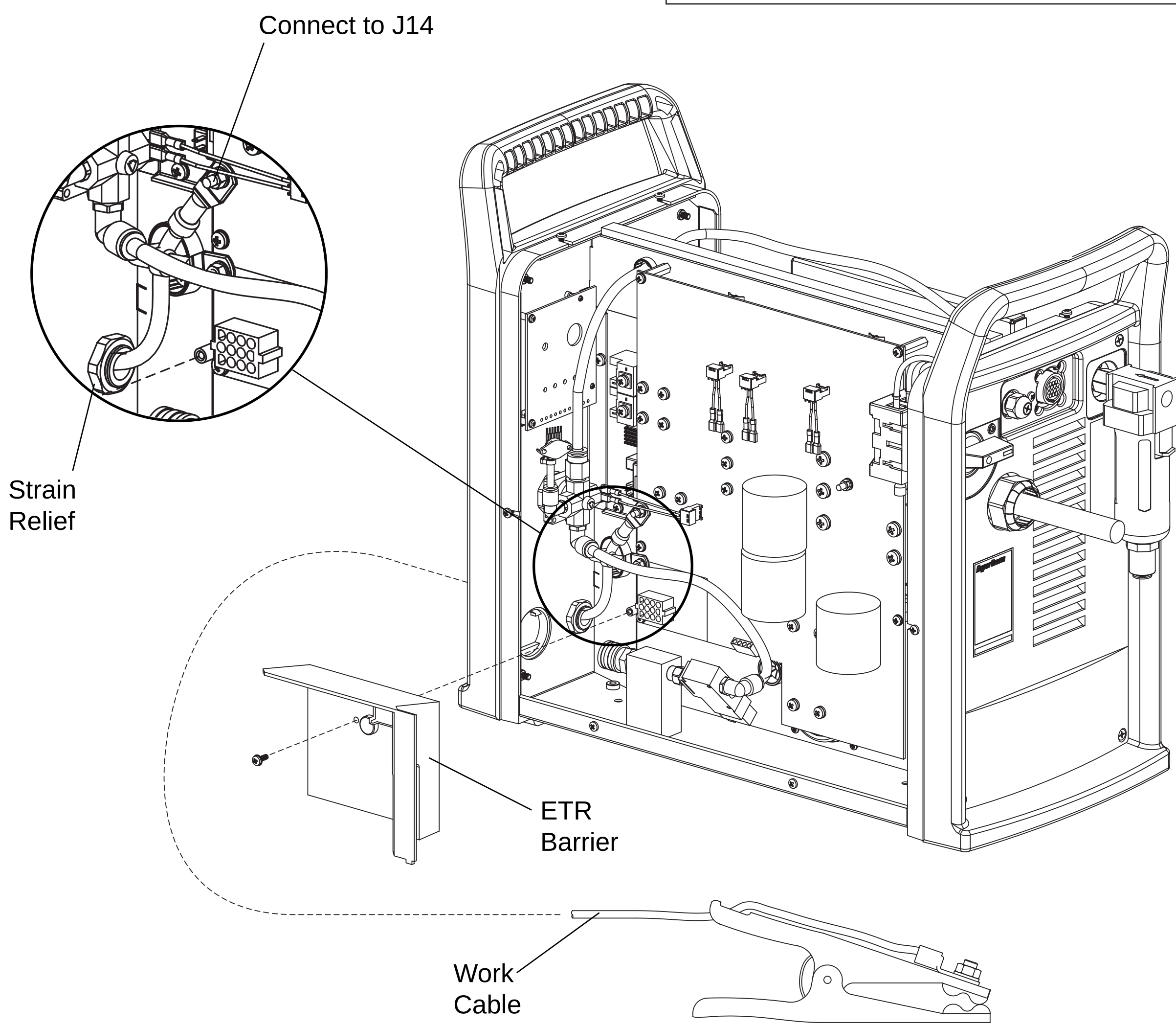
Work Cable Replacement

Disconnect electrical power, gas supply, and torch lead before removing the old work cable.

Installation – Refer to figure below.

1. Install the strain relief to the power supply and secure with nut.
2. Tighten the strain relief collar onto the cable.
3. Connect the work cable to the power board at J14.
   Tighten nut to 10 in-lb (12 kg cm) of torque.
4. Install ETR barrier
5. Install the power supply cover.

CAUTION: This is a high-current connection. Proper torque is critical.



Capacitor Replacement

Removal – Refer to figure below.

Disconnect electrical power and gas supply before removing the power supply cover.

Remove screws securing capacitor to PC board.

Remove fan assembly.

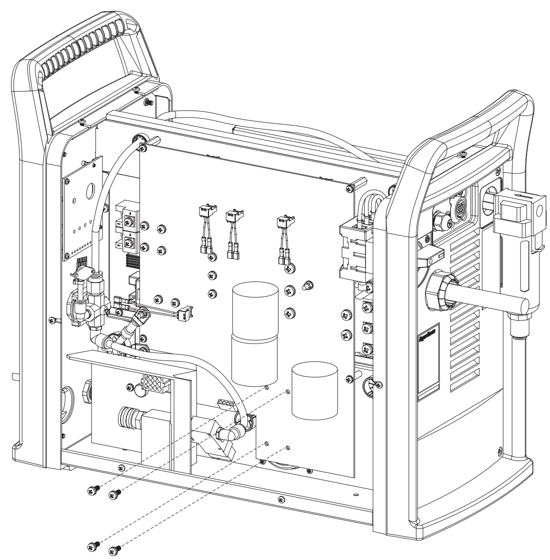
Remove capacitor from fan side of power supply.

Installation – Refer to figure below.

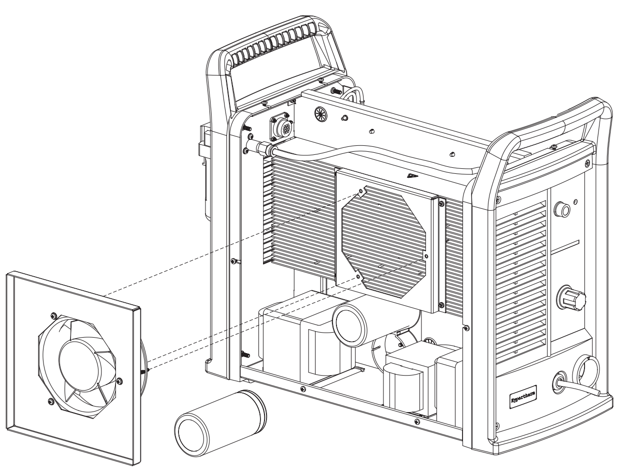
Align bleeder hole on capacitor with view hole on power board.

Install new capacitor and secure with 2 screws.
Tighten screws to 20 inch pounds (24 kg cm).

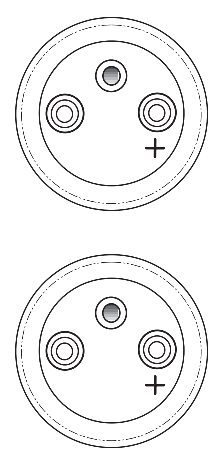
Install the power supply cover.



Remove and install screws
from power board side.



Remove and install
capacitors from fan side.

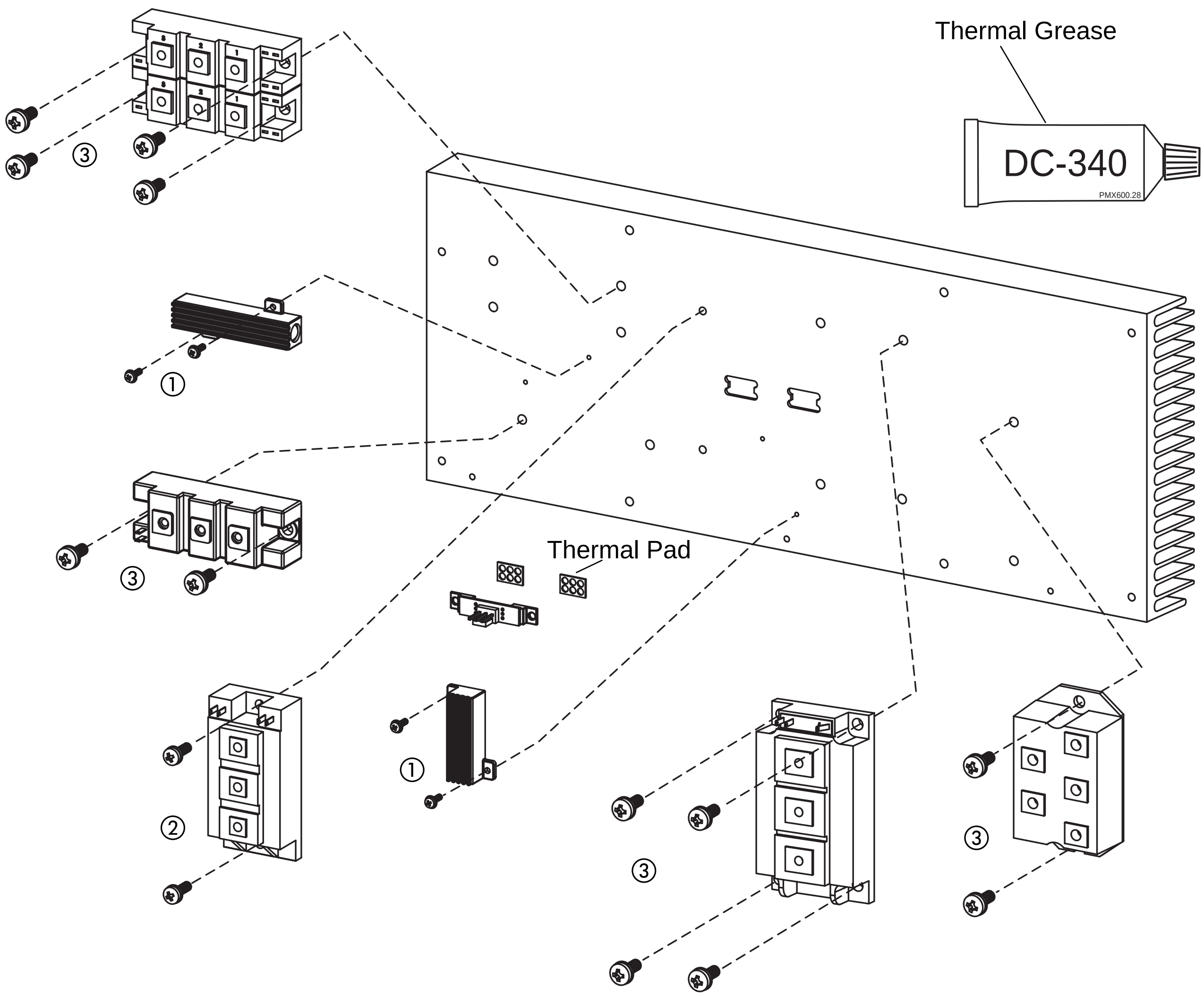


Correct Installation

Heat Sink Component Replacement

Installation

- Install components to the heat sink as shown below.
- Use new thermal pads on temperature sensor.
- Use thermal grease on all components. Apply a thin coat to the component, install with screws, and tighten to required torque.
- Re-torque after 2 minutes. Repeat until torque is maintained. Clean excess grease from heat sink.



Notes:

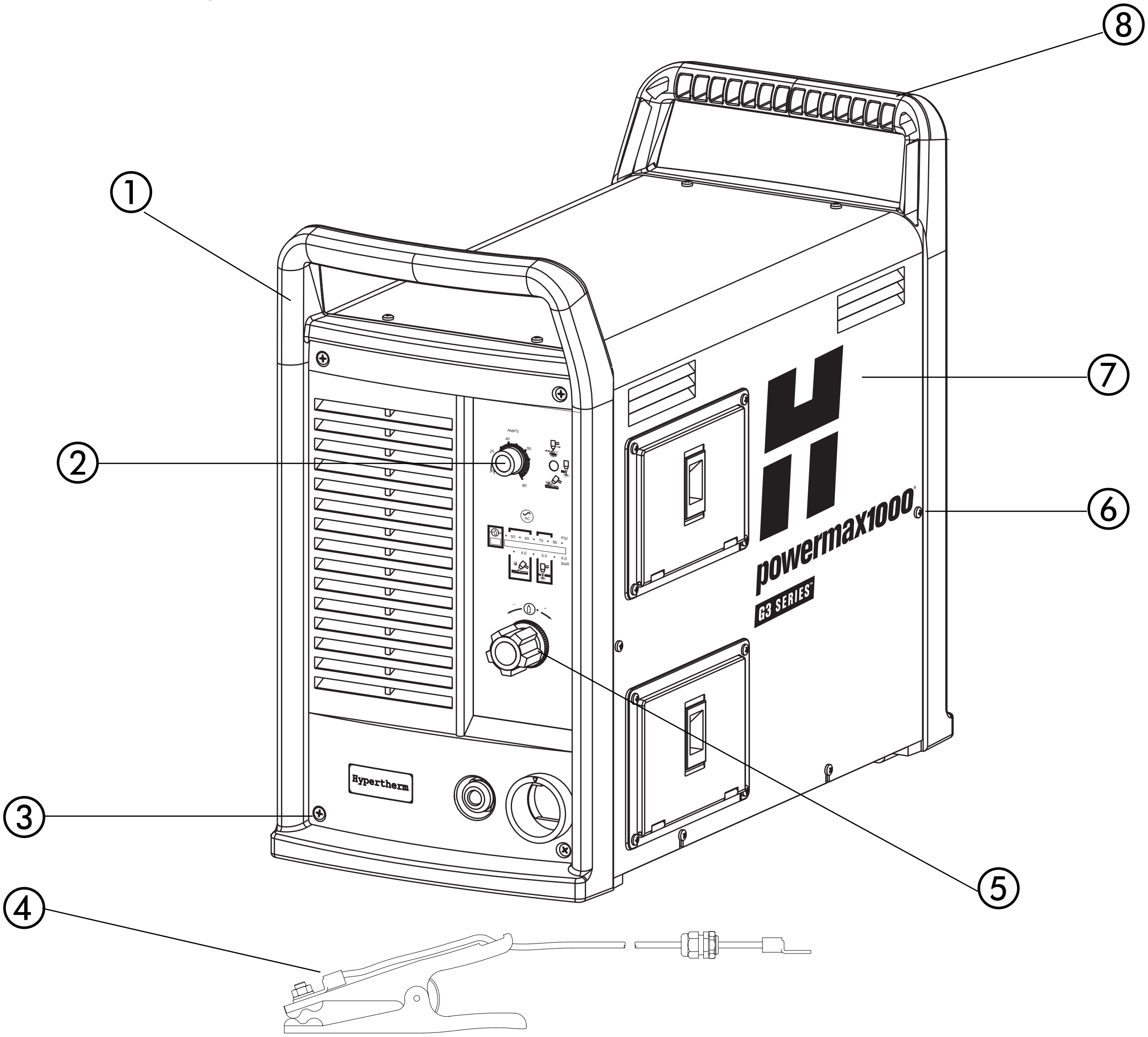
1 Apply thermal grease and torque to 8 in-lb (9 kg cm.)
2 Apply thermal grease and torque to 20 in-lb (23 kg cm).
3 Apply thermal grease and torque to 35 in-lb (40 kg cm).

Section 4

PARTS LIST - POWER SUPPLY

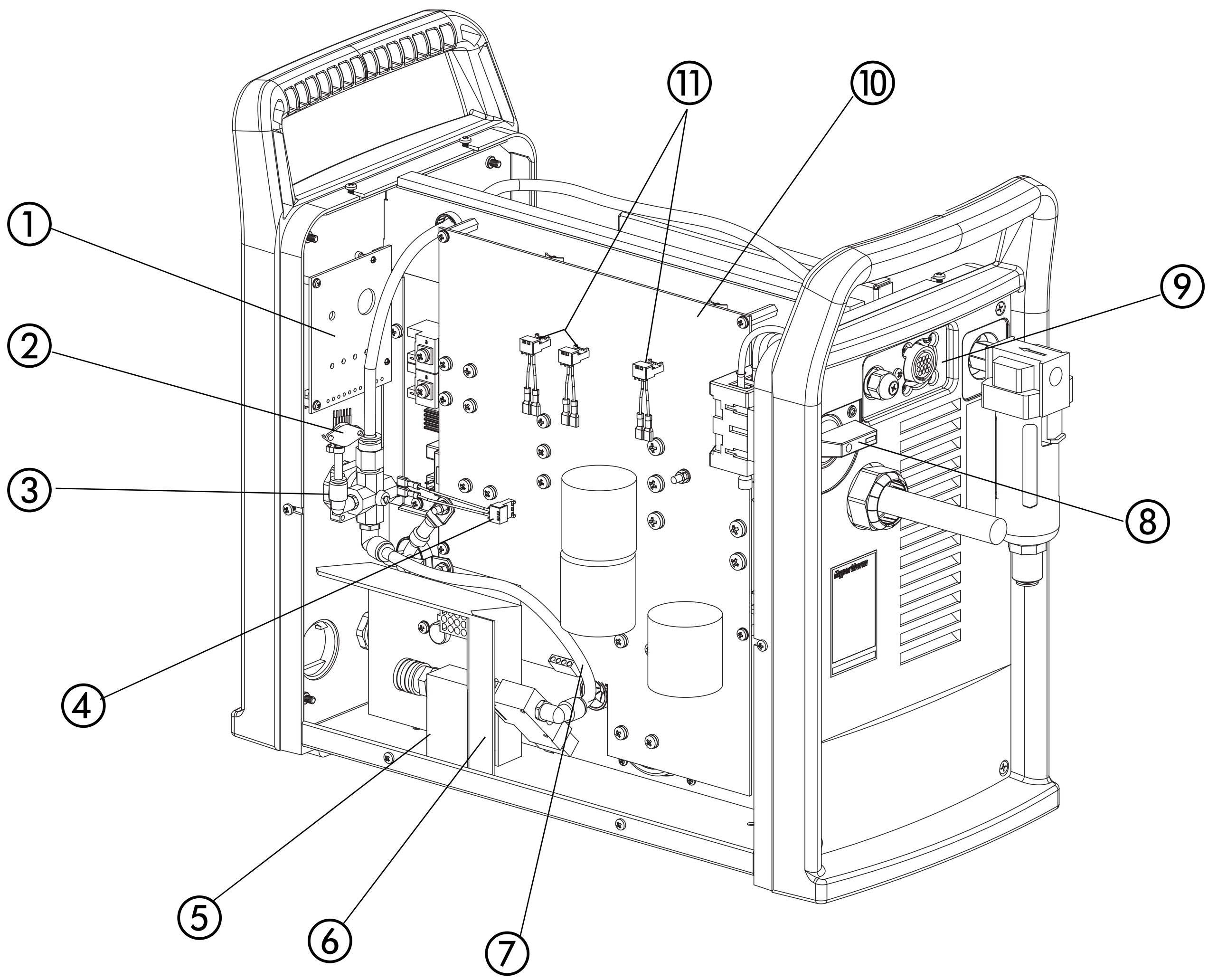
In this section:

Power Supply – Exterior



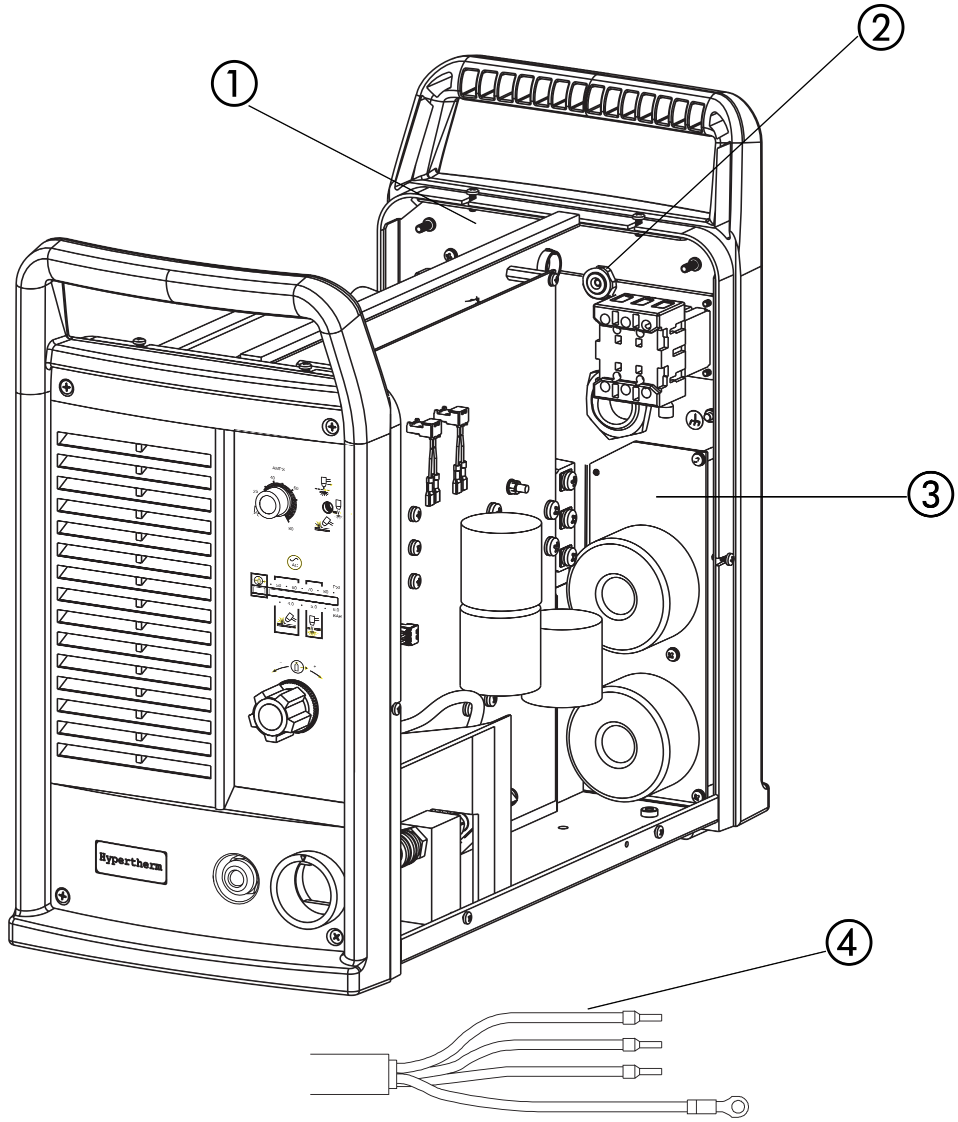
Item	Part Number	Description	Designator	Qty.
	128686	Label Kit, Domestic		1
	128685	Label Kit, CE		1
1	128689	Front end panel, Domestic		1
	128687	Front end panel, CE		1
2	008965	Current adjustment knob		1
3	128630	End cap screws		8
4	123645	Ground clamp		1
5	011096	Regulator knob		1
6	128629	Cover screws		12
7	128690	Power supply cover with labels, Domestic		1
	128688	Power supply cover with labels, CE		1
8	128626	Rear end panel		1

Power Supply – Interior Right Side



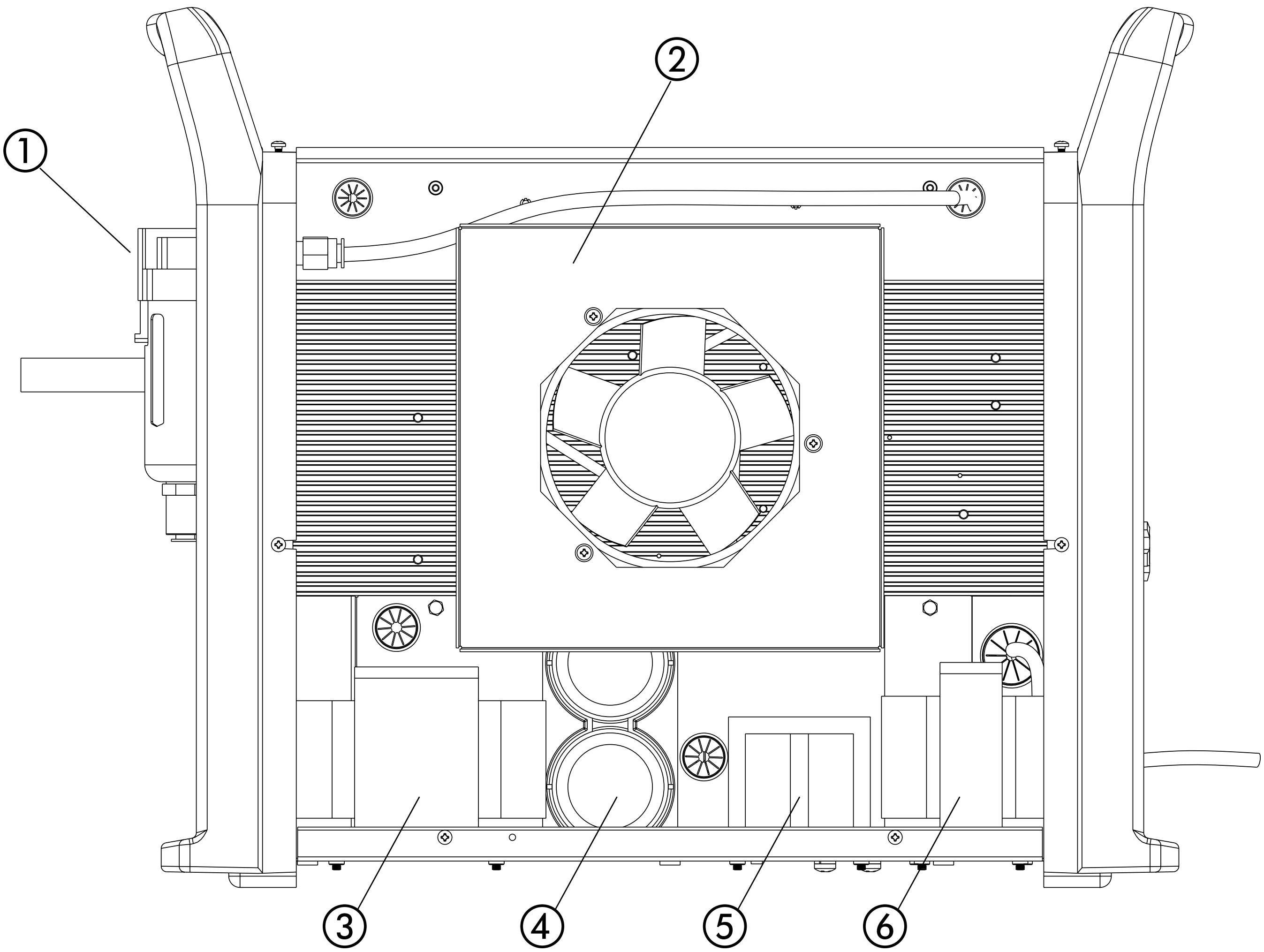
Item	Part Number	Description	Designator	Qty.
1	128701	Control PCB assembly, Domestic	PCB3	1
	128702	Control PCB assembly, CE	PCB3	1
2	128659	Pressure Transducer		1
3	128623	Pressure Regulator		1
4	128699	Pilot Arc IGBT Gate Drive Cable		1
5	128622	Gas Manifold	V1	1
6	128628	ETR Box		1
7	046116	Tubing, 8mm OD, 6mm ID, nylon		3 ft.
8	108211	On/Off Knob		1
9	128662	Machine interface		1
10	128695	Power PCB	PCB2	1
11	123602	Gate Drive Cables		3

Power Supply – Back Interior Right Side



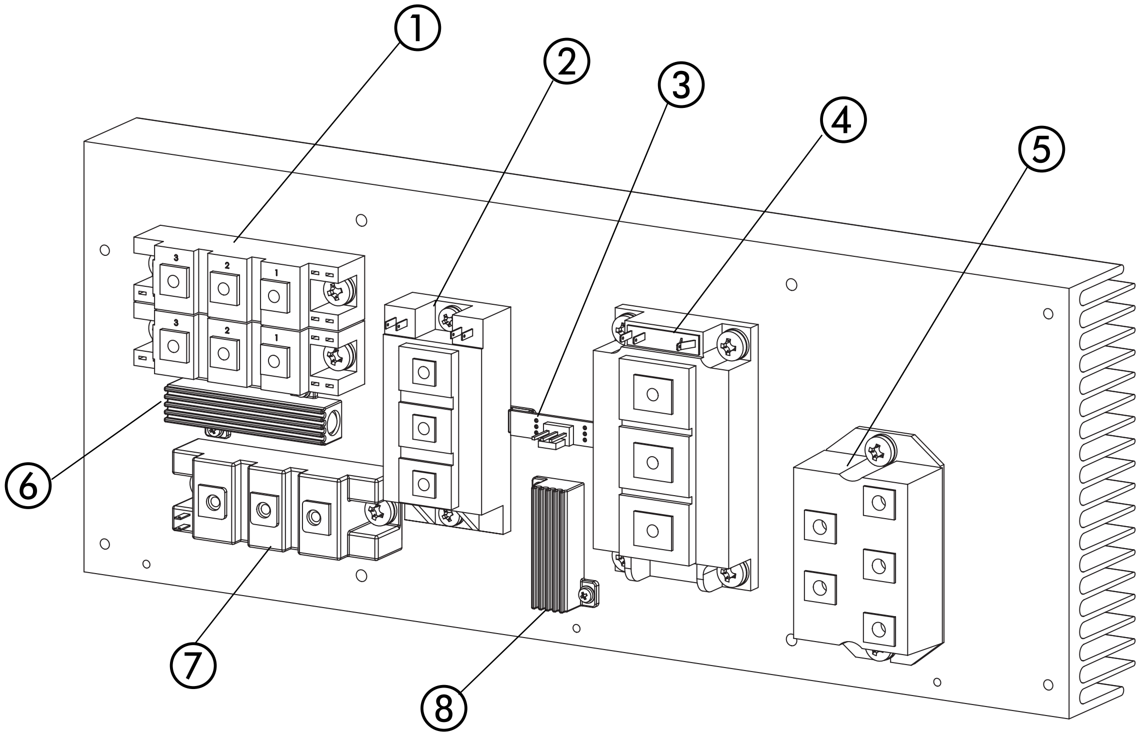
Item	Part Number	Description	Designator	Qty.
1	128665	Strain relief, arc voltage		1
2	128672	Power switch	S1	1
3	128706	EMI Filter PCB, CE only	PCB1	1
4	128666	Power cable, Domestic 3PH		1
	128705	Power cable, CE 3PH		1

Power Supply – Interior Fan Side



Item	Part Number	Description	Designator	Qty.
1	128627	Filter bowl		1
	011093	Air filter element		1
	011094	O-ring		1
2	128707	Fan subassembly	M1	1
3	128693	Inductor, input choke	L2	1
4	128691	Capacitor		2
5	128692	Power transformer	T2	1
6	128694	Inductor, output choke	L1	1

Power Supply – Heat Sink Assembly



Item	Part Number	Description	Designator	Qty.
	027662	Thermal grease, 5 oz. DC-340		1
1	128677	Output diode bridge		1
2	128697	IGBT, inverter	Q6	1
3	128700	Temperature Switch	PCB4	1
4	128708	IGBT, PFC	Q7	1
5	128696	Input diode bridge	D24	1
6	128670	Snubber resister		1
7	128699	IGBT, pilot arc		1
8	128669	Snubber resister		1

Reference page 3-24 for torque specifications.

Recommended Spare Parts – Powermax1000

Part Number	Description	Page Reference
128689	Front end panel, Domestic	4-2
128687	Front end panel, CE	4-2
128626	Rear end panel	4-2
008965	Current adjustment knob	4-2
128686	Labels, Domestic	4-2
128685	Labels, CE	4-2
128690	Power supply cover, Domestic	4-2
128688	Power supply cover, CE	4-2
128701	Control PCB assembly, Domestic	4-3
128702	Control PCB assembly, CE	4-3
128623	Pressure regulator	4-3
128622	Gas manifold	4-3
123645	Work cable with clamp, 15 ft (4.6 m)	4-3
128695	Power PCB	4-3
128662	Machine interface	4-4
128665	Strain relief, arc voltage	4-4
128672	Power switch	4-4
128706	EMI Filter PCB, CE only	4-4
128666	Power cable, Domestic 3PH	4-4
128705	Power cable, CE 3PH	4-4
128627	Filter bowl	4-5
011093	Air filter element	4-5
011094	O-ring, filter bowl	4-5
128707	Fan subassembly	4-5
128692	Power transformer	4-5
128691	Capacitor	4-5
128693	Inductor, input choke	4-5
128694	Inductor, output choke	4-5
027662	Thermal grease, 5 oz. DC-340	4-6
128677	Output diode bridge	4-6
128697	IGBT, inverter	4-6
128700	Temp switch	4-6
128708	IGBT, PFC	4-6
128696	Input diode bridge	4-6
128670	Snubber resister	4-6
128699	IGBT, pilot arc	4-6
128669	Snubber resister	4-6

Hypertherm

Section 5

PARTS LIST - TORCH AND CONSUMABLES

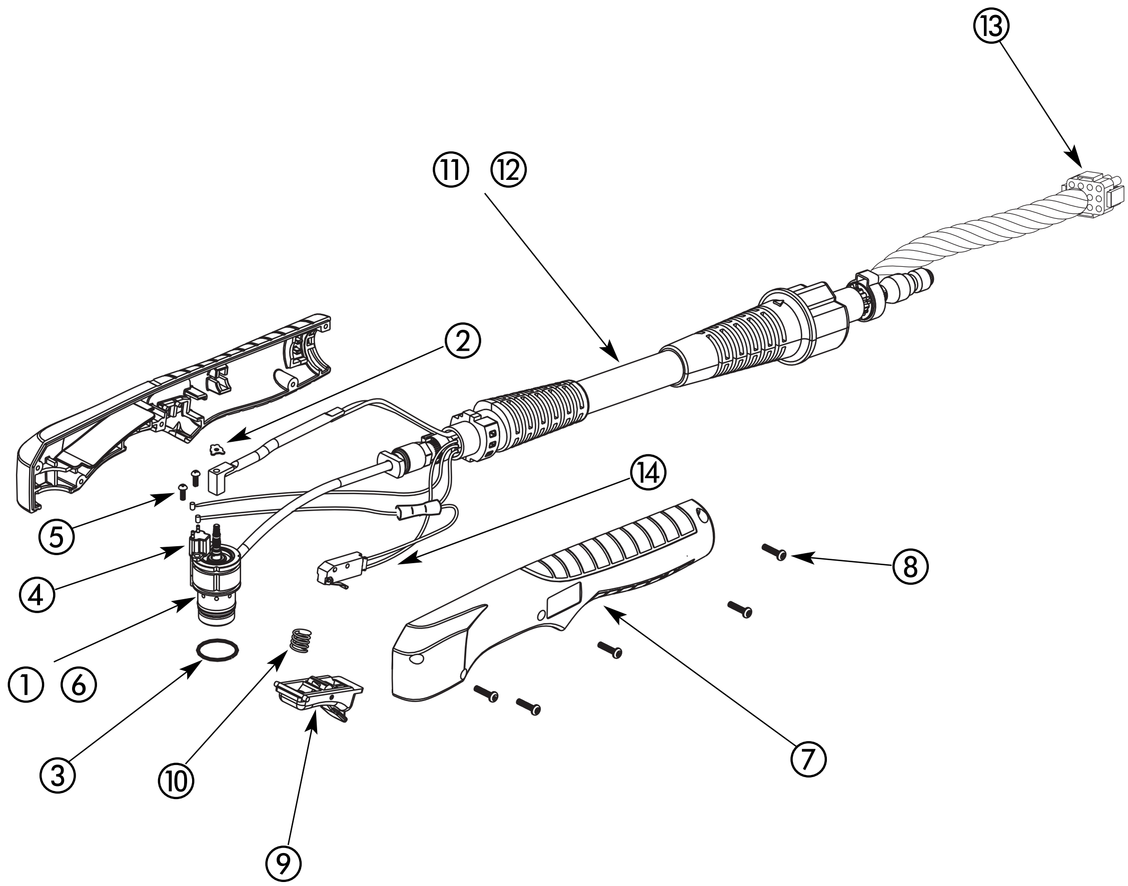
In this section:

T60 Hand Torch Assembly

Item	Part Number	Description	Quantity
	083172*	T60 Hand Torch Assembly with 25 ft (7.6 m) Lead	
	083171*	T60 Hand Torch Assembly with 50 ft (15.2 m) Lead	
1	128564	T60 Torch Main Body Replacement	1
2	027889	Retaining Clip	1
3	058519	O-ring	1
4	128639	Cap-off Sensor Replacement	1
5	075571	Cap-off Sensor screws	2
6	128521	T60/T60M Torch Head Repair Kit	1
7	128644	Handle Kit	1
8	075586	Handle screws	5
9	002244	Safety Trigger	1
10	027254	Spring	1
11	128681	25 ft (7.6 m) Torch Lead Replacement	1
12	128682	50 ft (15.2 m) Torch Lead Replacement	1
13	128638	ETR Repair Kit (Regional Repair Centers only)	1
14	128642	Start Switch	1

* Top assembly includes the following consumables (See page 4-3 for details of consumable parts):

120926	Electrode	1
120925	Swirl Ring	1
120928	Retaining Cap	1
120929	Shield	1
120931	Nozzle	1

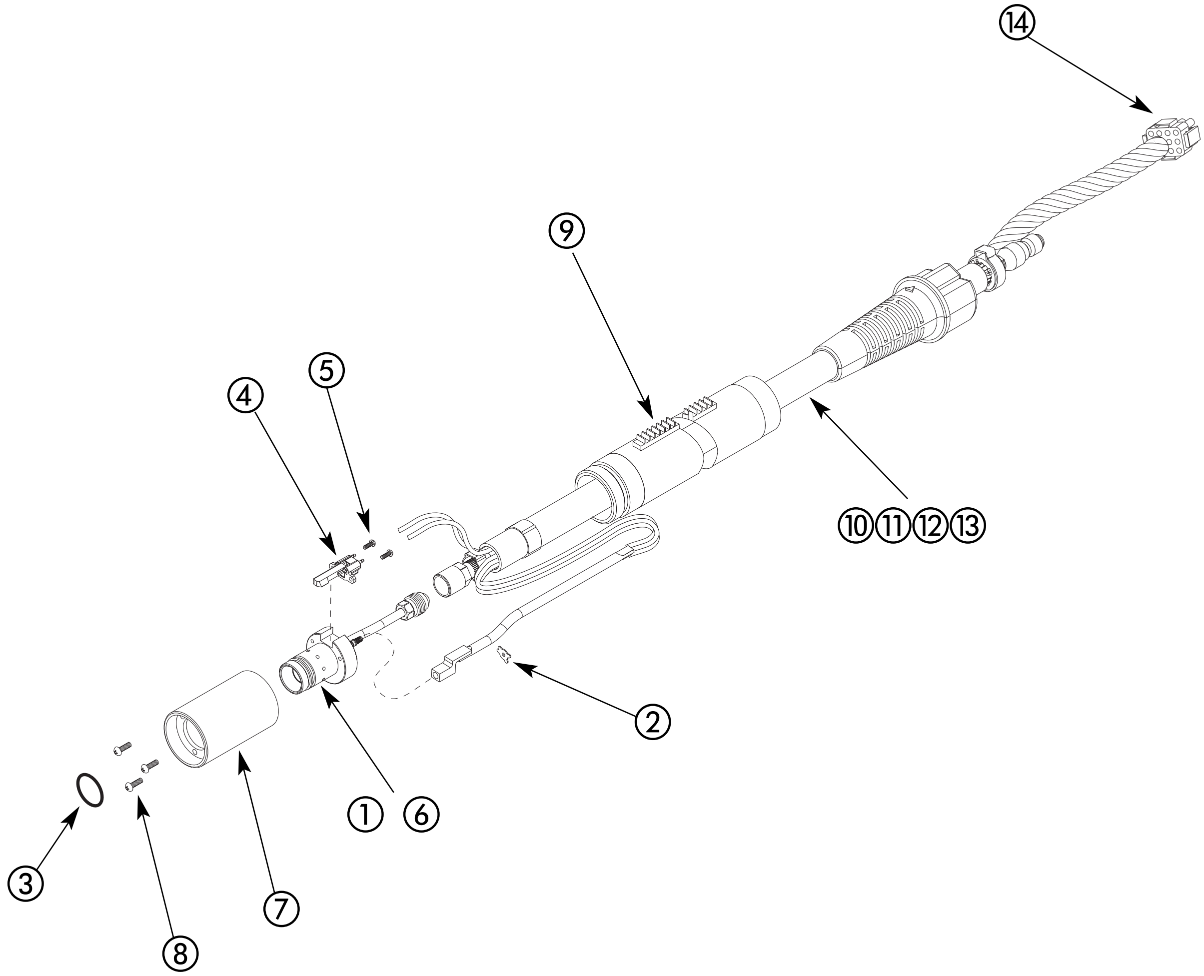

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T60M Machine Torch Assembly

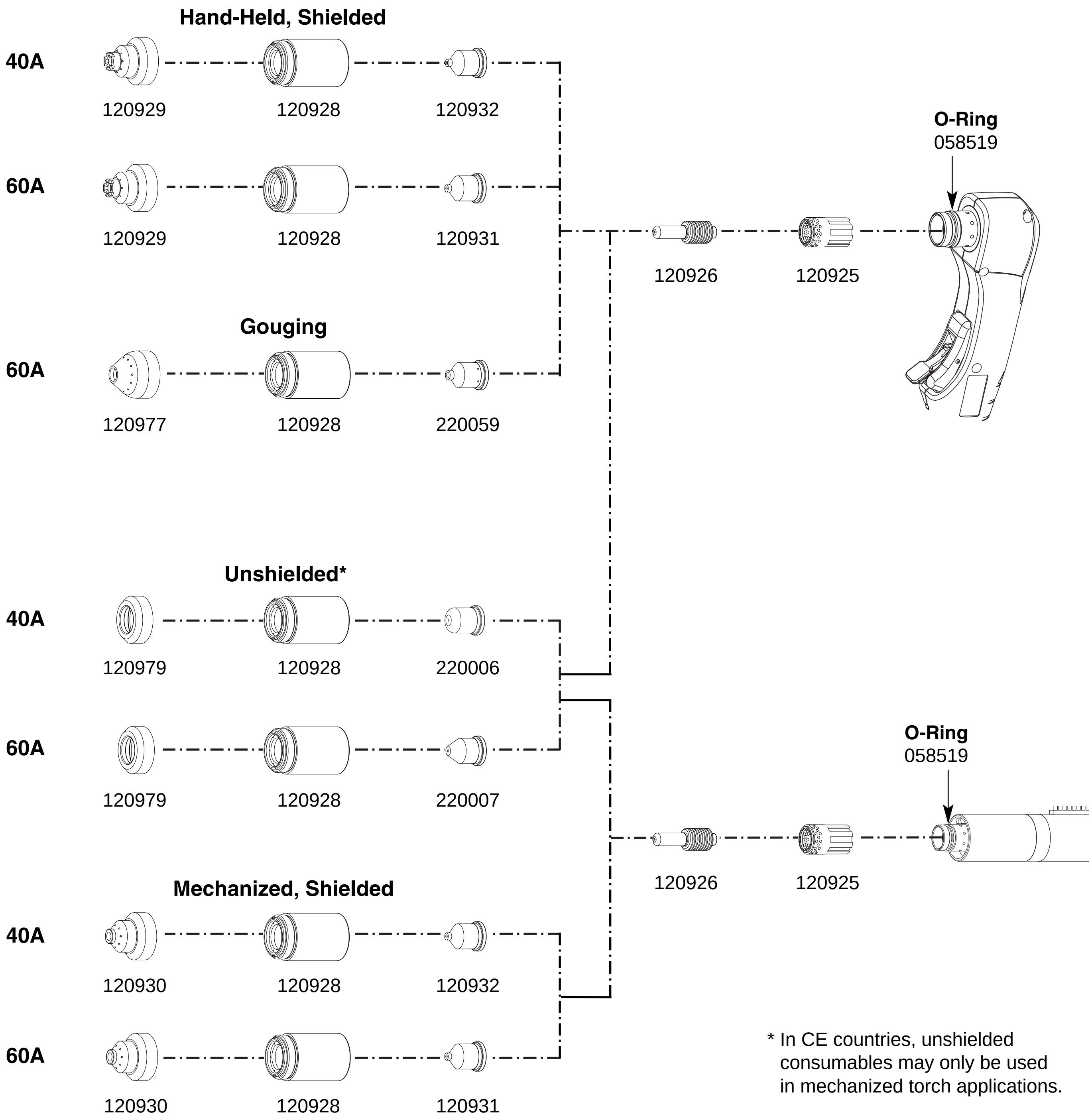
Item	Part Number	Description	Quantity
	083175*	T60M Machine Torch Assembly with 15 ft (4.6 m) Lead	
	083174*	T60M Machine Torch Assembly with 25 ft (7.6 m) Lead	
	083176*	T60M Machine Torch Assembly with 35 ft (10.7 m) Lead	
	083177*	T60M Machine Torch Assembly with 50 ft (15.2 m) Lead	
1	128640	T60M Torch Main Body Replacement Kit	1
2	027889	Retaining Clip	1
3	058519	O-ring	1
4	128639	Cap-off Sensor Replacement Kit	1
5	075571	Cap-off Sensor Screws	2
6	128521	T60/T60M Torch Head Repair Kit	1
7	128643	Torch Mounting Sleeve Replacement Kit	1
8	075004	Torch Mounting Screws	3
9	128710	Torch Positioning Sleeve	1
10	128634	15 ft (4.6 m) Torch Lead Replacement Kit	1
11	128633	25 ft (7.6 m) Torch Lead Replacement Kit	1
12	128635	35 ft (10.7 m) Torch Lead Replacement Kit	1
13	128641	50 ft (15.2 m) Torch Lead Replacement Kit	1
14	128638	ETR Repair Kit (Regional Repair Centers only)	1
	128645	Torch Mounting Kit (for reassembly after installation)	1

* Top assembly includes the following consumables (See page 4-3 for details of consumable parts):

120926	Electrode	1
120925	Swirl Ring	1
120928	Retaining Cap	1
120929	Shield	1
120931	Nozzle	1


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Torch Consumable Configurations



* In CE countries, unshielded consumables may only be used in mechanized torch applications.

Recommended Spare Parts

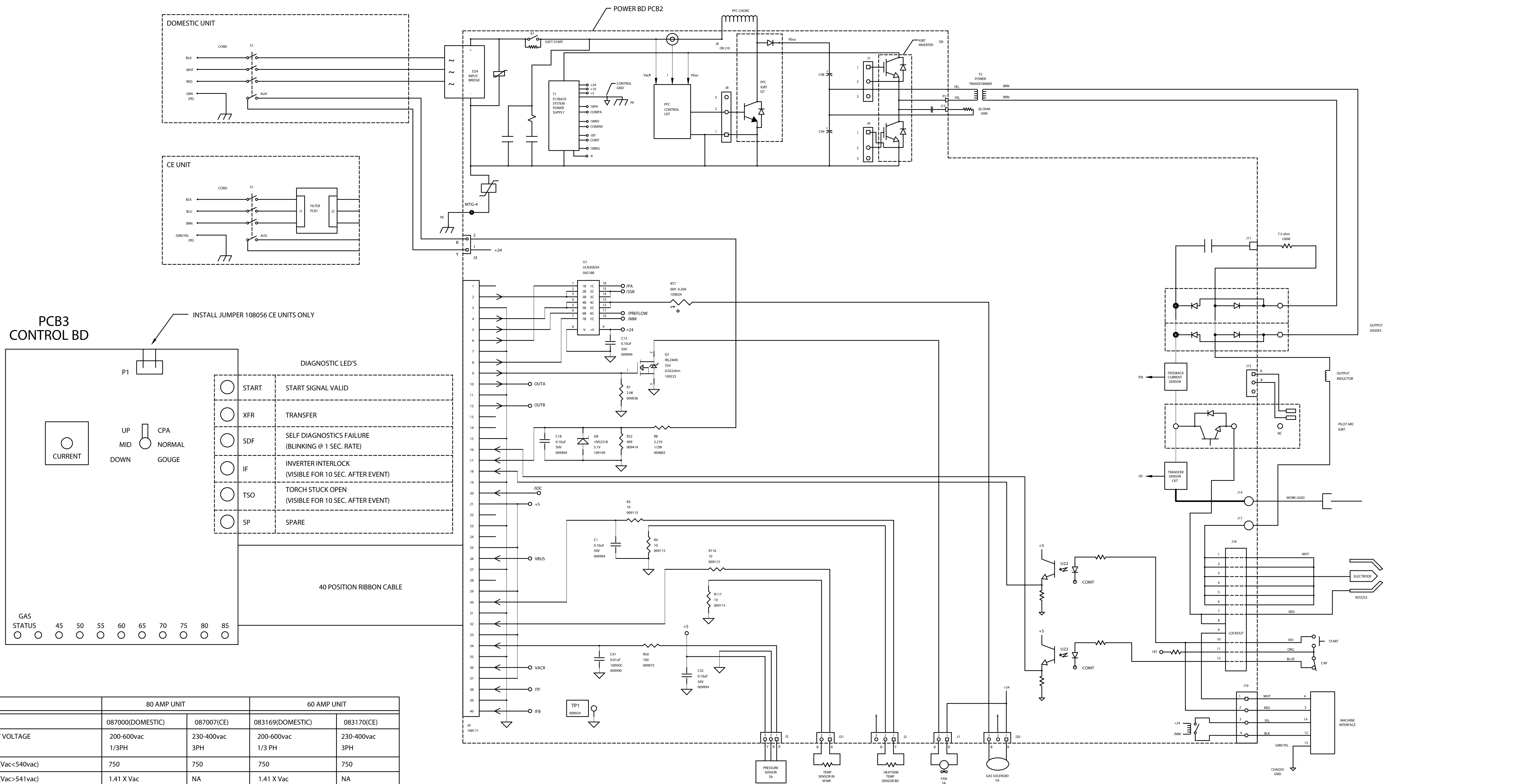
Part Number	Description
058519	Torch O-Ring
027055	Silicone Lubricant, 1/4 Oz. Tube
128644	T60/T80 Torch Handle Replacement Kit
128638	ETR Connector Replacement Kit (Regional Repair Centers only)
075586	T60/T80 Torch Handle Screw (5 required)
002244	T60/T80 Torch Trigger Assembly with Spring
027254	Replacement Trigger Spring, T60/T80
128642	T60/T80 Start Switch Replacement Kit
128564	T60/T80 Hand Torch Main Body Replacement Kit
128640	T60M/T80M Machine Torch Main Body Replacement Kit
128521	T60/T80/T60M/T80M Torch Head Repair
027889	Retaining Clip
128639	T60/T80/T60M/T80M Torch Cap Sensor Replacement
075571	Cap-off Sensor Screws
020620	Torch Positioning Sleeve, 32 Pitch, 10 Inches Rack (Standard)
120668	Torch Positioning Sleeve without Rack, 1-3/8 Inches Diameter
075004	Torch Mounting Screws
087001	T60/T80 Hand Torch Assembly with 25 ft (7.6 m) Lead
087002	T60/T80 Hand Torch Assembly with 50 ft (15.2 m) Lead
128637	T60/T80 Hand Torch Replacement Lead 25 ft (7.6 m)
128636	T60/T80 Hand Torch Replacement Lead 50 ft (15.2 m)
087003	T60M/T80M Machine Torch Assembly with 15 ft (4.6 m) Lead
087004	T60M/T80M Machine Torch Assembly with 25 ft (7.6 m) Lead
087005	T60M/T80M Machine Torch Assembly with 35 ft (10.7 m) Lead
087006	T60M/T80M Machine Torch Assembly with 50 ft (15.2 m) Lead
128634	T60M/T80M Machine Torch Replacement Lead 15 ft (4.6 m)
128633	T60M/T80M Machine Torch Replacement Lead 25 ft (7.6 m)
128635	T60M/T80M Machine Torch Replacement Lead 35 ft (10.7 m)
128641	T60M/T80M Machine Torch Replacement Lead 50 ft (15.2 m)
128643	T60M/T80M Mounting Sleeve Replacement Kit
128645	T60M/T80M Mounting Kit

Section 6

WIRING DIAGRAMS

In this section:

REVISIONS					
REV	ECN	DATE	DRAWN	DATE	APPROVED
A	11948	1-26-01	MWW		
B	12637	11-2-01	LMB	11/5/01	DMB



	80 AMP UNIT		60 AMP UNIT	
	087000(DOMESTIC)	087007(CE)	083169(DOMESTIC)	083170(CE)
INPUT VOLTAGE	200-600vac 1/3PH	230-400vac 3PH	200-600vac 1/3 PH	230-400vac 3PH
Vbus (Vac<540vac)	750	750	750	750
Vbus (Vac>541vac)	1.41 X Vac	NA	1.41 X Vac	NA
CORD	129652	129653	129652	129726
WIRE GROUP	123607	129683	129732	129739
MACHINE INTERFACE CABLE	123603	123603	123603	123603
POWER SWITCH (S1)	003206	003206	005257	005257
FILTER (PCB1)	NA	041660	NA	041773
POWER BD (PCB2)	041667	041667	041746	041746
CONTROL BD (PCB3)	041663	041707	041709	041710
TEMP SENSOR BD (PCB4)	041723	041723	041713	041713
TIMING DIAGRAM	013341	013341	013341	013341

NOTES:
1. PIN 6 IS KEYING FEATURE ON 60A
2. PIN 9 IS LOCKOUT FEATURE

MATERIAL

UNLESS OTHERWISE SPECIFIED:
DIMENSIONS ARE IN INCHES.
TOLERANCES ARE:
2 PL DECIMAL ±.01
3 PL DECIMAL ±.005
FRACTIONS ±1/64
ANGULAR ±.5∞
PART MUST BE FREE OF BURRS AND SHARP EDGES. BREAK SHARP EDGES IF NECESSARY WITH CHAMFER OR RADIUS .015 MAX.

Hypertherm
Box-5010 Hanover, NH 03755-5010 603/643-3441

DESCRIPTION			
ELEC SCHEM: 60/80A SYS (B)			
ITEM NO. 013342	FILE NAME 013342	SCALE 1=1	SHEET 1 OF 1
DRAWN BY MWW	DATE 5-11-01	APPROVED BY	DATE